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AD NUMBER

AD359527

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NRL ltr, 19 Jun 2002; NRL ltr, 19 Jun 2002

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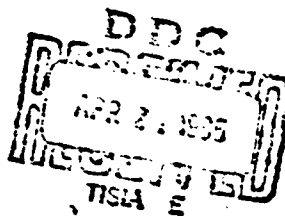
**Field Strengths of Some VLF Transmissions
and Atmospheric Noise Measured in
European and Asian Areas
June 1962 Through May 1963**

[Unclassified Title]

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March 2, 1965



U.S. NAVAL RESEARCH LABORATORY
Washington, D.C.

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CONTENTS

ABSTRACT	ii
PROBLEM STATUS REPORT	ii
AUTHORIZATION	ii
INTRODUCTION	1
TRANSMISSION PATHS	1
TABLE 1 - Location of Data Recording Stations and periods of Operation	3
TABLE 2 - Location of U. S. Navy Transmitters	3
DATA RECORDING AND PROCESSING METHODS	4
Atmospheric Noise	4
Signal Field Strengths	4
TABLE 3 - Average Radiation Resistance for VLF Transmitters	5
Signal-to-Noise Ratios	5
Transmitter Radiated Power	5
TABLE 4 - Monthly Average Radiated Power for NAA	7
TABLE 5 - Monthly Average Radiated Power for NEA, NPG, and NPM	8
RESULTS	9
TABLE 6 - Figure Number Index of the Included Data	11
REFERENCES	12
NORMALIZATIONS	13

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ABSTRACT
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The Naval Research Laboratory is conducting an investigation of very-low-frequency (VLF) radio wave propagation at great distances and over a long period of time. The statistical relationship of the field strength of various VLF transmissions and atmospheric noise and the signal-to-noise ratios with the time of day and season of the year is being investigated. Between December 1958 and approximately March 1964 the subject propagation data has been recorded at the following sites: Hammerfest, Bodø and Værhø, Norway; Rome, Italy; Haifa, Israel; and Karachi, West Pakistan.

This is the fourteenth in a series of quarterly reports, covering the fifteenth through the eighteenth quarters since the program began. During the period covered by this report, June, 1962 through May, 1963, Karachi was in operation the entire time and Hammerfest was in operation through May, 1963.

PROBLEM STATUS

This is an interim report on one phase of the problem. Work is continuing on this and other phases.

AUTHORIZATION

NRL Problem P01-33
BUSHIPS PROJECT SR 008-01-01

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FIELD STRENGTHS OF SOME VLF
TRANSMISSIONS AND ATMOSPHERIC NOISE
MEASURED IN EUROPEAN AND ASIAN AREAS
JUNE, 1962 THROUGH MAY, 1963

INTRODUCTION

The Naval Research Laboratory is conducting an investigation of very-low-frequency (VLF) radio wave propagation at great distances and over a long period of time. For this investigation, the field strengths of various VLF transmissions and atmospheric noise have been continuously recorded at several sites on the coasts of Europe and the Near East from December 1958 through March 1964. Extension of the project through the spring of 1964 was primarily intended for obtaining coverage data on the Navy's new VLF transmitting facility at Cutler, Maine which commenced operation in January 1961.

The routine output data is being published in installments covering each quarter of the year, grouped according to the seasons. This series of reports will not contain an analysis of the data. Analysis and correlation of the data with various geophysical phenomena will be the subject of other reports. This report is the fourteenth in the series of these installments and covers the fifteenth through the eighteenth quarters, June 1962 through May, 1963. Reference 1 covered two quarters.

TRANSMISSION PATHS

During the period covered in this report, field strengths of VLF transmissions and atmospheric noise were recorded at Hammerfest, Norway, and Karachi, Pakistan. The precise locations of these recording sites are given in Table 1. The locations of the U. S. Navy VLF transmitters are given in Table 2.

A VLF recording site was installed in Karachi, West Pakistan in June 1961 and was operated through March, 1964. However, due to the severe environmental conditions, other local problems, and the use of the unreliable instrumentation discussed above, many equipment outages resulted. As a consequence, consistent, usable data were

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not obtained for continuous periods of sufficient duration to justify processing until March 1962.

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TABLE I

Locations of Data Recording Stations and Periods of Operation

<u>Station</u>	<u>Location</u>		<u>Period of Operation</u>
	<u>Latitude</u>	<u>Longitude</u>	
Sode	37° 16.5'N	14° 21.4'E	Dec 1958 - Sep 1960
Varhaug	33° 37.5'N	5° 37.3'E	Dec 1958 - Mar 1962
Rome	42° 52' N	12° 40' E	Dec 1958 - Aug 1960
Hammerfest	70° 39' N	23° 37' E	Jun 1959 - Dec 1959 Mar 1961 - Mar 1963
Haifa	32° 46' N	35° 2' E	Jun 1959 - May 1962
Karachi	24° 54' N	67° 2' E	Jun 1961 - Mar 1964

TABLE 2

Locations of U. S. Navy VLF Transmitters

<u>Station</u>	<u>Location</u>	
<u>Call Letters</u>	<u>Latitude</u>	<u>Longitude</u>
NSS	36° 59.1'N	76° 27.2'W
NPG	46° 12' N	121° 55' W
NFM	21° 25.5'N	158° 9.7'W
NDT	34° 58.3'N	137° 1.3'E
NAA	44° 33.9'N	67° 16.9'W
NBA	9° 3.3'N	70° 38.9'W

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DATA RECORDING AND PROCESSING METHODS

All field strength data reported herein were recorded using a 10-foot, vertical, ferrite (whip) antenna. One such antenna is installed at each data recording station. A broadband antenna coupler is used to couple the antenna to AN/URM-133 and AN/URM-6 field strength meters which drive Esterline-Angus strip chart recorders. The whip antenna system is calibrated periodically using a loop antenna.

The U. S. Navy transmitters "locked key" for three minutes and, immediately preceding or following, are "off" for three minutes once each hour. It is during these periods that the subject data were recorded.

Atmospheric noise

The atmospheric noise field strengths reported are average values recorded once each hour during the three minute "off" period of the transmitters discussed above. The AN/URM-133 equipments have a nominal noise bandwidth of 40 cps while the noise bandwidth of the AN/URM-6 equipment varies between about 100 and 200 cps depending upon the frequency to which it is tuned. All atmospheric noise field strengths have been normalized to a bandwidth of 100 cps.

Signal Field Strengths

The signal field strengths given in this report are average values over the three minute "locked key" period recorded once each hour, and normalized to a radiated power of one kilowatt. The signal field strengths are calculated from the measurements of the average signal plus noise and the average noise made during the locked-key and off periods of the transmitters. The radiated power during each locked-key period is determined from a measurement of the average transmitting antenna current during each period and the average radiation resistance of the antenna. The radiation resistance values used for each transmitter are given in Table 1. The radiation resistance of each transmitting station is periodically measured and the value appropriately changed if necessary. Although the radiation resistance of NPO appears to have a seasonal dependency, an average value is used throughout

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the year since the effect on the radiated power is slight.

TABLE 3

AVERAGE RADIATION RESISTANCE FOR VLF TRANSMITTERS

Station	Frequency kc	Radiation Resistance ohms
NAA	14.7	0.078
NDA	18.0	0.069
NPG	18.8	0.079
NPM	19.8	0.072
NSS	22.3	0.134

Signal-to-Noise Ratios

The signal to atmospheric noise ratios for each hourly locked-key and off period reported are the ratios of the locked-key field strengths normalized to a radiated power of one kilowatt, to the average atmospheric noise field strengths normalized to a 100 cps bandwidth.

Transmitter Radiated Power

As previously stated, the field strengths of all transmissions reported herein have been normalized to a radiated power of one kilowatt. The radiated power during each field strength measurement is calculated by squaring the average transmitting antenna current measured during each locked-key period and multiplying by the average value of radiation resistance (Table 3). To determine the various propagation effects, it is necessary to normalize the data to a constant radiated power. However, for planning communication circuits

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and determining the reliability of the circuits, it is necessary to know the radiated power capability of each transmitting facility.

In Tables 1 and 2 the average radiated power for each transmitter for each month is given along with the number of monthly periods during which the locked-key test was not transmitted. For approximately six hours each week, NAA operates with only half of its transmitting system for routine maintenance. Although these periods have been referred to as "half-power" transmissions, the reduction in radiated power during such operation is considerably more than 1 db. These "half-system" transmitting periods were not used in determining the average radiated power from NAA because normally the signal is undetectable at all data recording stations during these periods. The NAA transmitter also operates periodically from half of the system at a reduction in radiated power of approximately 1 db. Since these "half-power" transmissions can be received at all of the data recording stations, they are not omitted in computing the monthly average radiated power, as is the case with NBB. In Table 3 the monthly average radiated power is computed separately for the full and "half-power" transmissions.

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TABLE 6
MONTHLY AVERAGE RADIATED POWER FOR HAA

STATION	F.L. No.	MONTHLY	AVERAGE RADIATED POWER IN KW		NUMBER OF LOCKED KEYS	
			1st	2nd	Full Power	Half Power
HAA	19.7	Jan 62	1010.9	30.0	81	0
		Jul 62	874.8	29.7	26.2	26
		Aug 62	868.1	29.4	26.2	20
		Sep 62	901.7	29.6	26.2	134
		Oct 62	798.7	29.0	26.1	161
		Nov 62	897.8	29.5	26.2	108
		Dec 62	896.0	29.5	26.2	157
		Jan 63	900.0	29.5	26.2	145
		Feb 63	838.1	29.5	26.2	161
		Mar 63	319.1	25.0	0	261
		Apr 63	746.0	28.7	25.1	30
		May 63	901.6	29.6	26.1	23

* First Column Indicates Average Power During Full Power Locked Keys
Second Column Indicates Average Power During Half Power Locked Keys

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Table 3
MONTHLY AVERAGE RADIATED POWER FOR HRA, HPG, HRP

STATION	FREQUENCY KC	MONTH YEAR	AVERAGE RADIATED POWER DB ABOVE 1 MC		NUMBER OF LOCKED-KEY PERIODS	
			KW	PERCENT	Transmitted	Spilled
HRA	18.0	Jun 62	18.6	12.7	681	39
	18.0	Jul 62	17.4	12.4	718	26
	18.0	Aug 62	17.7	12.5	680	24
	18.0	Sep 62	17.4	12.4	674	46
	18.0	Oct 62	18.6	12.7	693	51
	18.0	Nov 62	18.3	12.6	669	51
	18.0	Dec 62	18.0	12.5	690	54
	18.0	Jan 63	17.9	12.5	692	52
	18.0	Feb 63	17.0	12.3	635	85
	18.0	Mar 63	16.7	12.2	653	91
	18.6	Jun 62	182.7	22.6	573 (34)*	133
	18.6	Jul 62	169.9	22.3	617 (25)*	107
HPG	18.6	Aug 62	139.6	21.5	263 (0)*	481
	18.6	Oct 62	159.5	22.0	404 (7)*	333
	18.6	Nov 62	153.1	21.9	528 (8)*	184
	18.6	Dec 62	154.6	21.9	476 (3)*	265
	18.6	Jan 63	154.6	21.9	340 (5)*	135
	18.6	Feb 63	174.0	22.4	182 (5)*	77
	18.6	Mar 63	167.4	22.3	478 (1)*	233
	18.6	Apr 63	172.5	22.4	439 (9)*	236
	19.6	Jun 62	82.4	19.2	337	383
	19.8	Aug 62	79.1	19.0	337	607
	19.8	Mar 63	82.4	19.2	528	616

* HALF POWER LOCKED-KEYS

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RESULTS

The data are reported in several forms as follows:

1. The mean plus and minus one standard deviation for the signal and the atmospheric noise field strengths and the signal-to-noise ratios for each hour of one day for a period of one month.

2. The mean for the signal field strengths and the signal-to-noise ratios for each hour of the day over approximately ten day periods of each month.

3. The probability distribution of the signal and the atmospheric noise field strengths and the signal-to-noise ratios for a period of one month.

NOTE: The probability distribution presented in the signal and noise data, separately, are not time correlated. That is, a high signal level did not necessarily occur simultaneously with a high noise level. Therefore, these two sets of data cannot be used for determining the signal-to-noise probability distribution. Graphs showing the true, signal-to-noise probability distribution are presented, however.

In processing the data included in this report, atmospheric noise field strengths are computed only for the hours during which a signal field strength is computed from a recorded locked key transmission. Ideally this occurs once an hour, every hour. Priority traffic and scheduled maintenance at the transmitter and emergence maintenance at the transmitting and receiving sites thwart efforts to attain the ideal situation. The actual number of recorded, locked key transmissions is indicated above each hourly plot on the monthly signal-to-noise ratio curves. These numbers apply to the signal and atmospheric noise field strengths as well as the signal-to-noise ratio calculations.

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During the period covered by this report, XAA, NBA, and NFB received good coverage at both Hammerfest and Karachi. NFM was not detectable often enough to provide meaningful data for most of the months covered.

NBA was off the air and NFB switched frequencies from 19.6 Mc to 19.0 Mc during the latter part of January and all of February, 1963. The radiation resistance reported for NFB in Table 3 was used for both NFB frequencies.

Additional information about atmospheric noise at many locations around the world and for the same period covered by this report may be found in references 3, 4, 5, and 6.

Figures 1 and 2 may be removed from the report and used for interpolation of the appropriate graph scales.

In March, 1962 new antenna couplers were installed at the Hammerfest and Karachi sites. The method used for determining the antenna factor with the new coupler was different than the method used with the old coupler by a factor of 6 db. Unfortunately this change was not incorporated in the computer program. As a consequence, all of the signal and noise field strengths from those stations are in error from that date. The correction factors are noted on the affected curves. THE SIGNAL-TO-NOISE RATIO CURVES ARE, OBVIOUSLY, NOT AFFECTED. THIS HAS BEEN REPORTED IN REFERENCE 7.

44:30:12

TABLE 6

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926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REFERENCES

1. NPL Memo Report 1-73 - 5 December 1963, by W. E. Garner, F. J. Rhoads, F. T. Elwood, III, and F. L. Schauer.
2. NPL Memo Report 1571 - 29 October 1964, by W. E. Garner, F. J. Rhoads, and F. L. Schauer.
3. "QUARTERLY Radio Noise Data - June, July, August 1962" by W. E. Crichton, F. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 19-15, dated 1 March 1963.
4. "QUARTERLY Radio Noise Data - September, October, November 1962" by W. E. Crichton, F. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 19-16, dated 15 June 1963.
5. "QUARTERLY Radio Noise Data - December, 1962; January, February 1963" by W. E. Crichton, F. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 19-17, dated 15 May 1964.
6. "QUARTERLY Radio Noise Data - March, April, May 1963" by W. E. Crichton, F. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 19-18, dated 25 July 1964.

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NORMALIZATIONS

The Field Strengths Of All Transmissions Are Normalized To A Radiated Power (P_r) Of One Kilowatt.

Atmospheric Noise Field Strengths Are Normalized To A Bandwidth of 100 Cycles Per Second.

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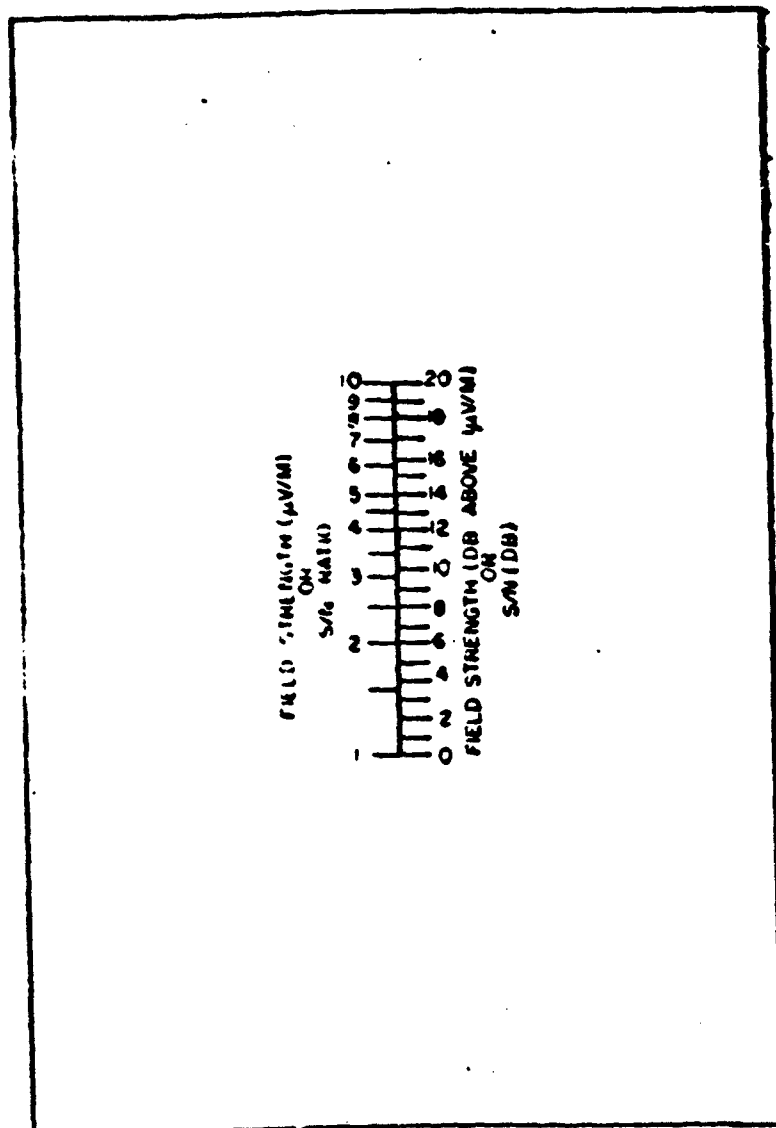


Figure 2

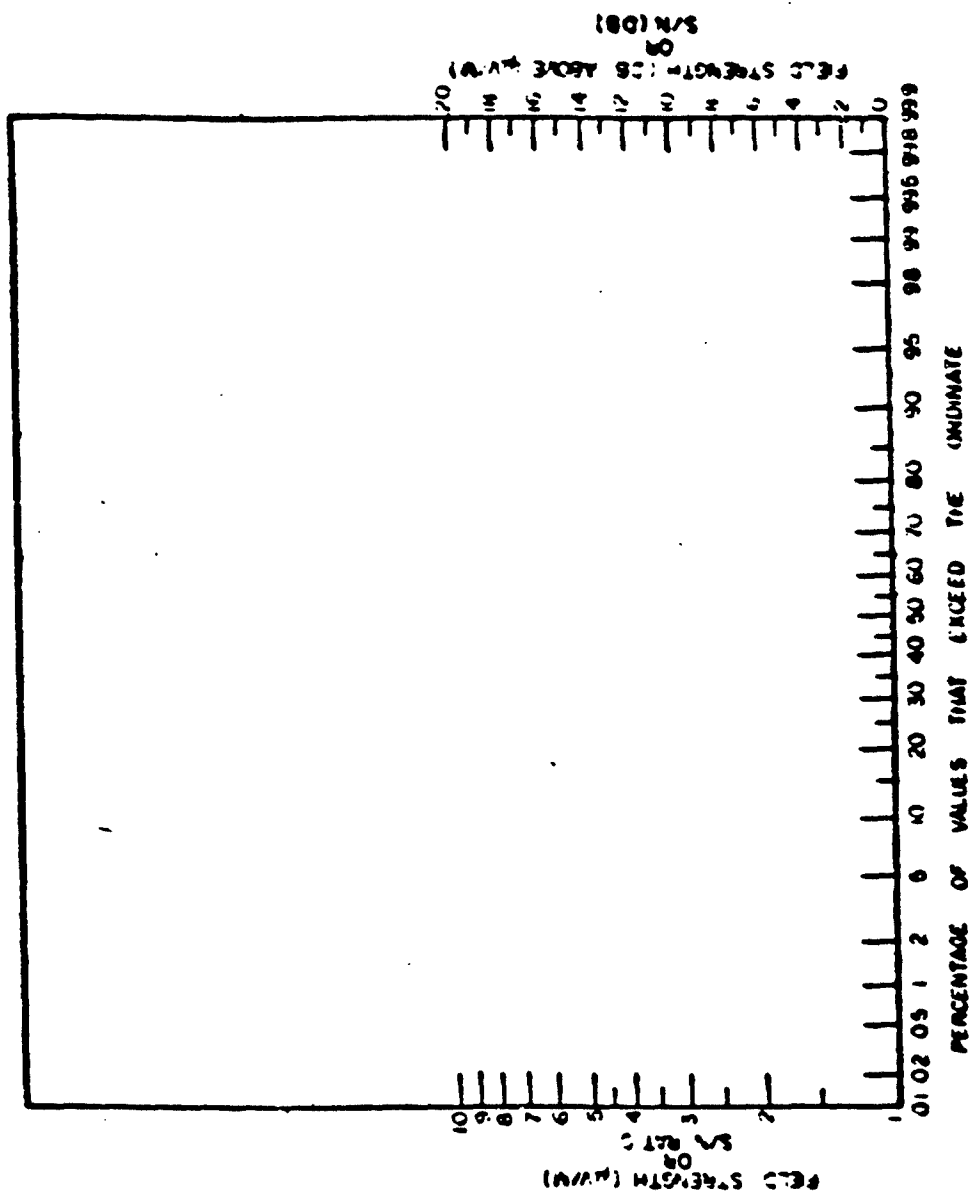


Figure 2

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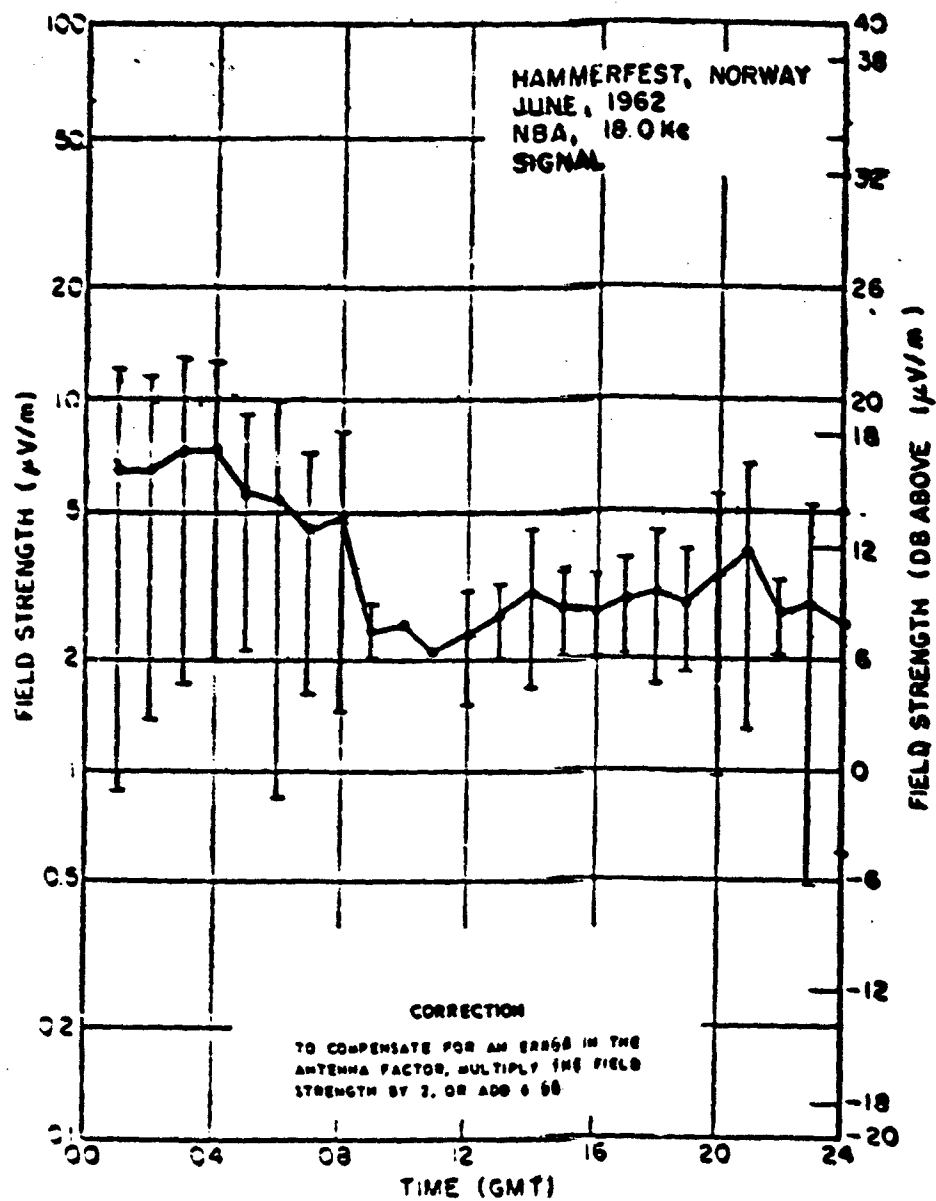


Figure 3

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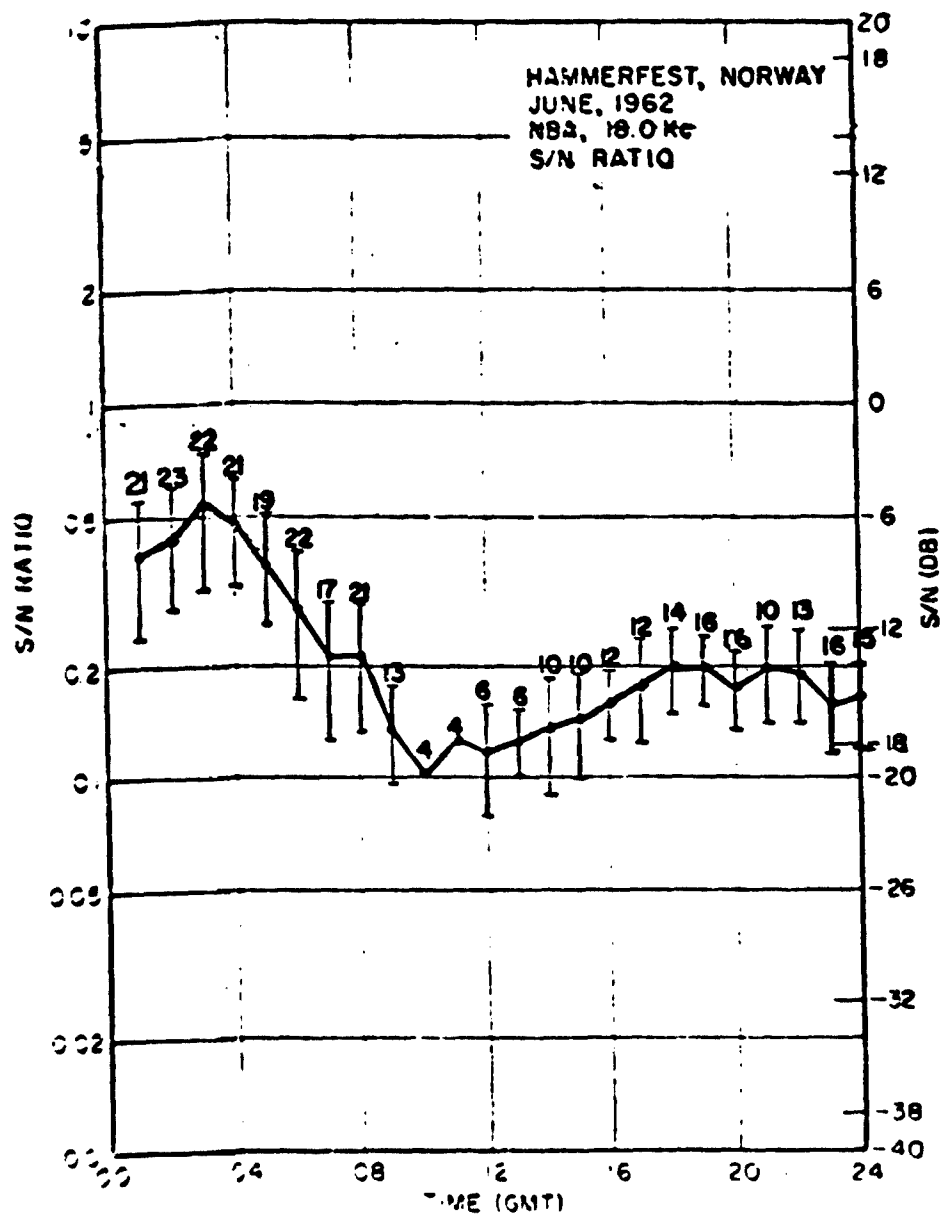


Figure 4

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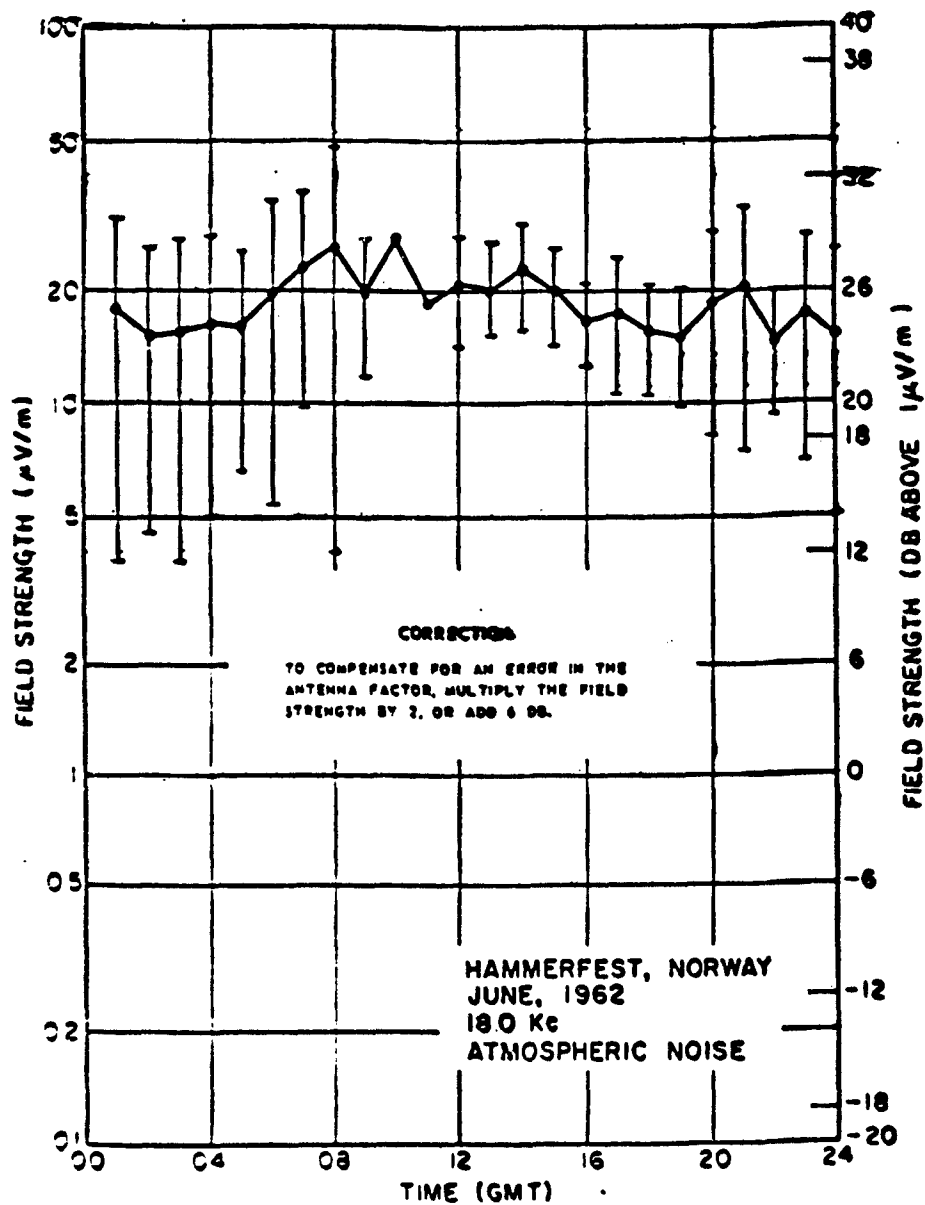


Figure 5

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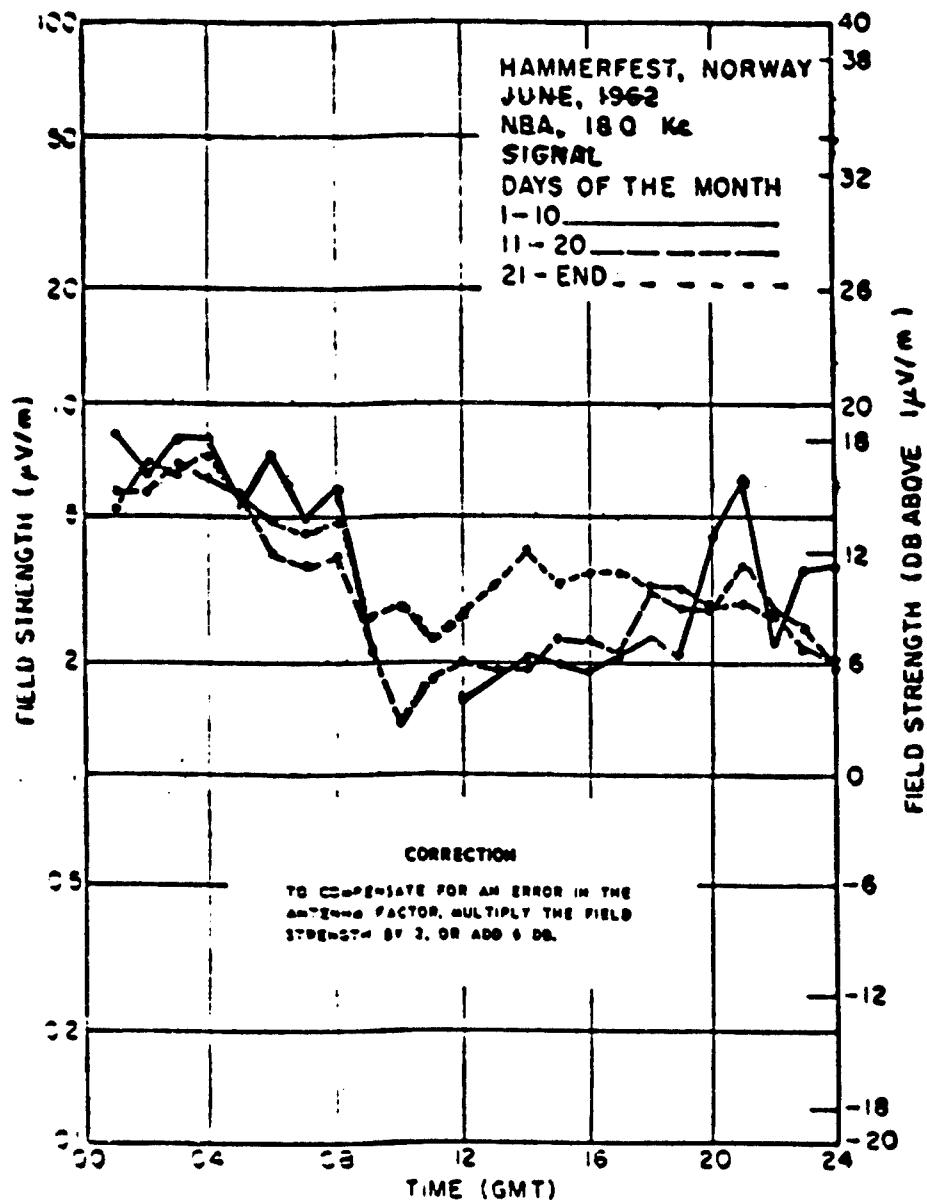


Figure 6

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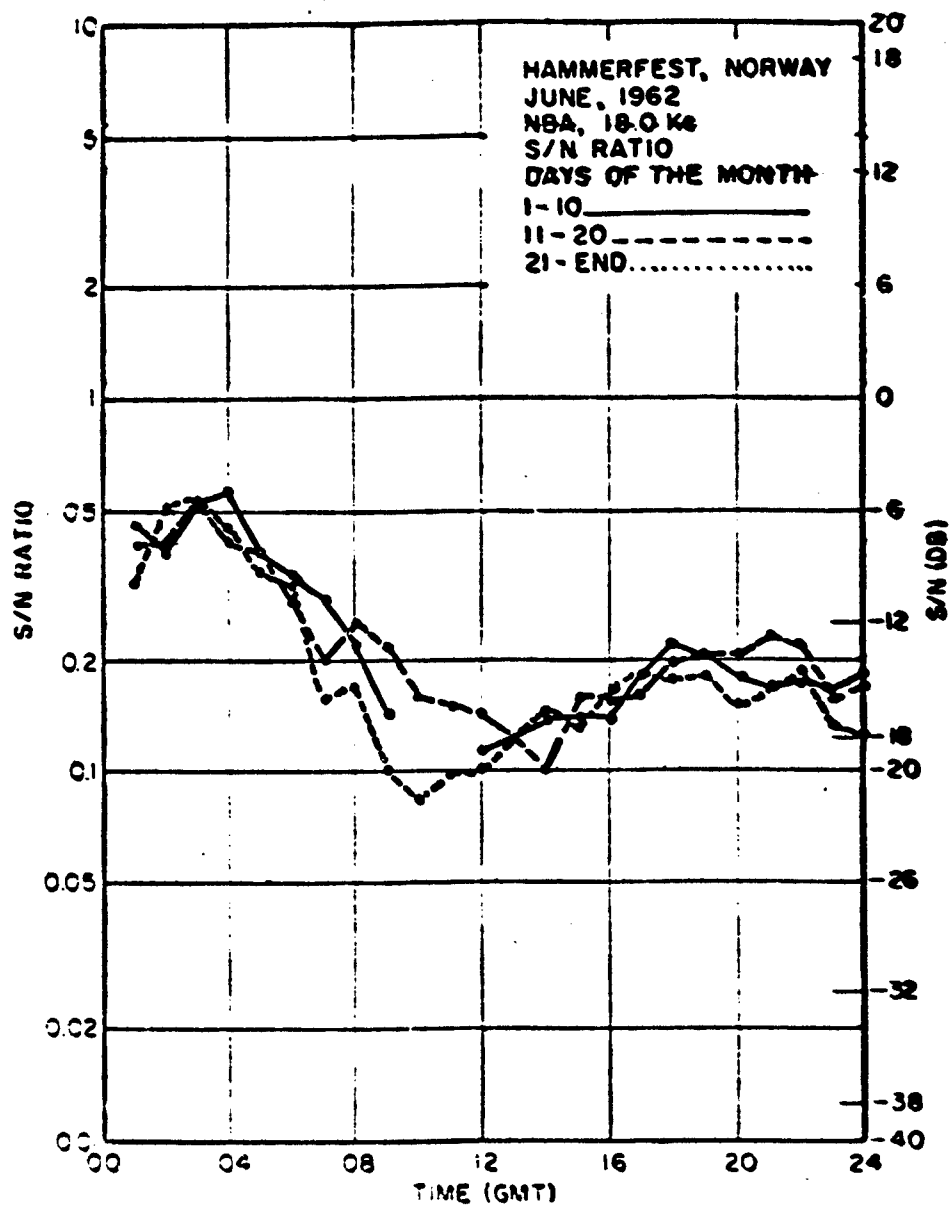


Figure 7

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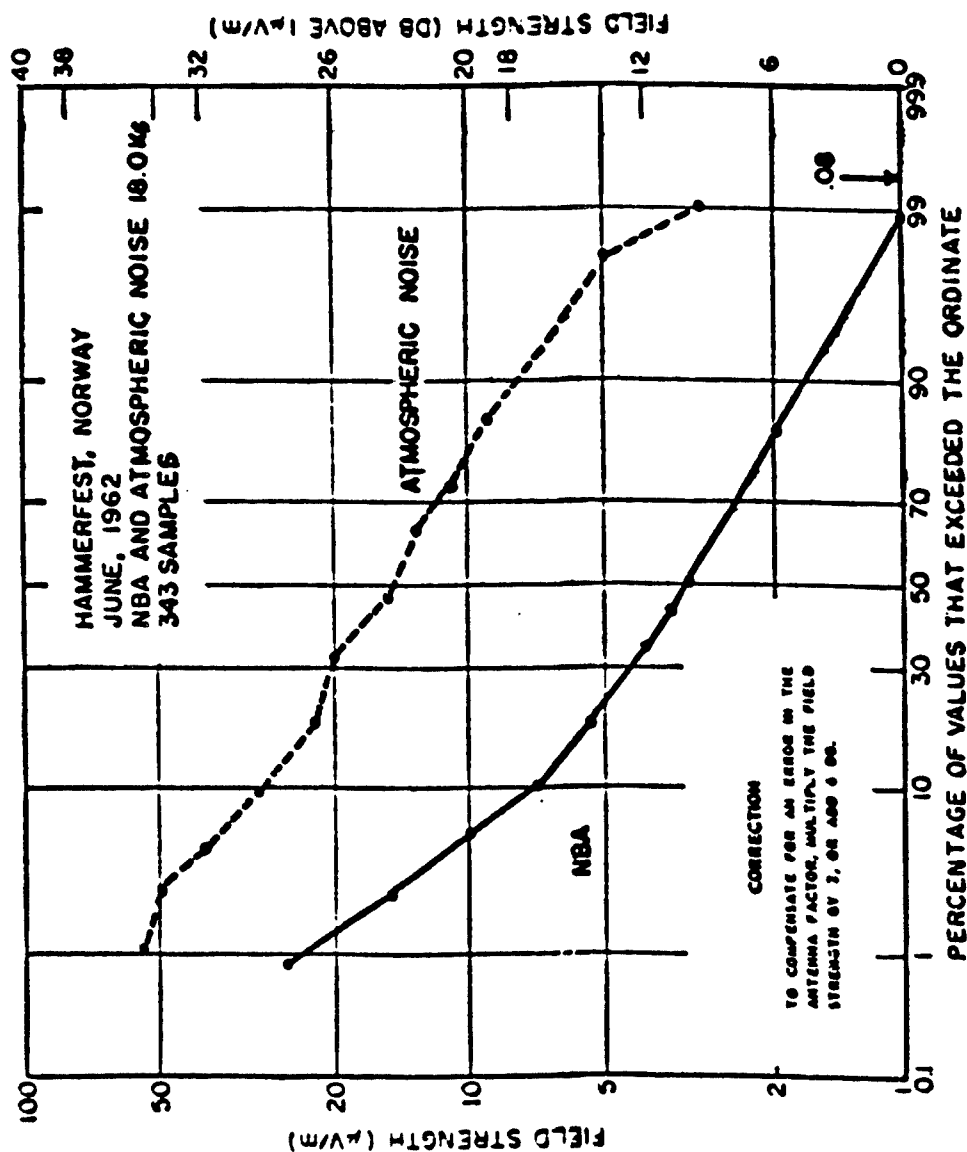


Figure 8

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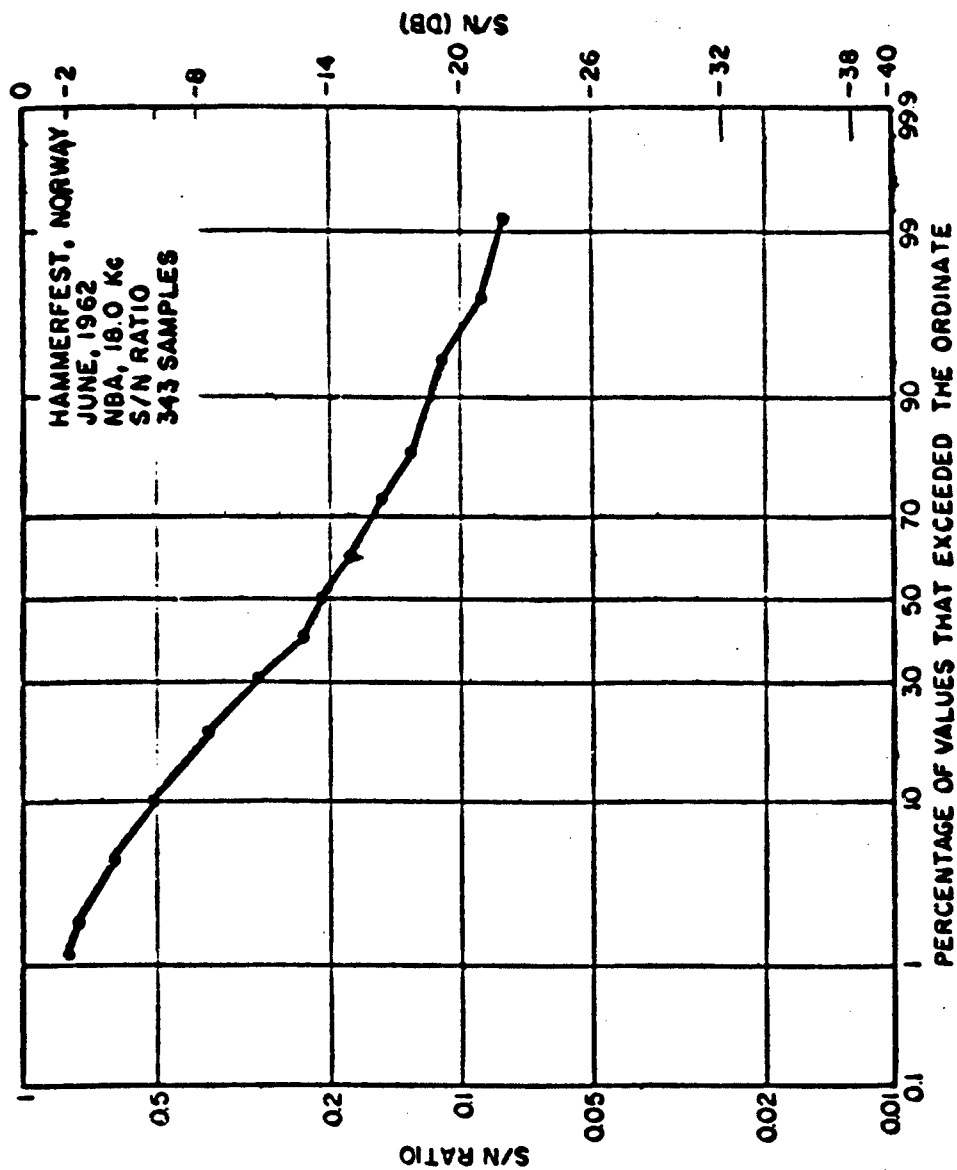


Figure 9

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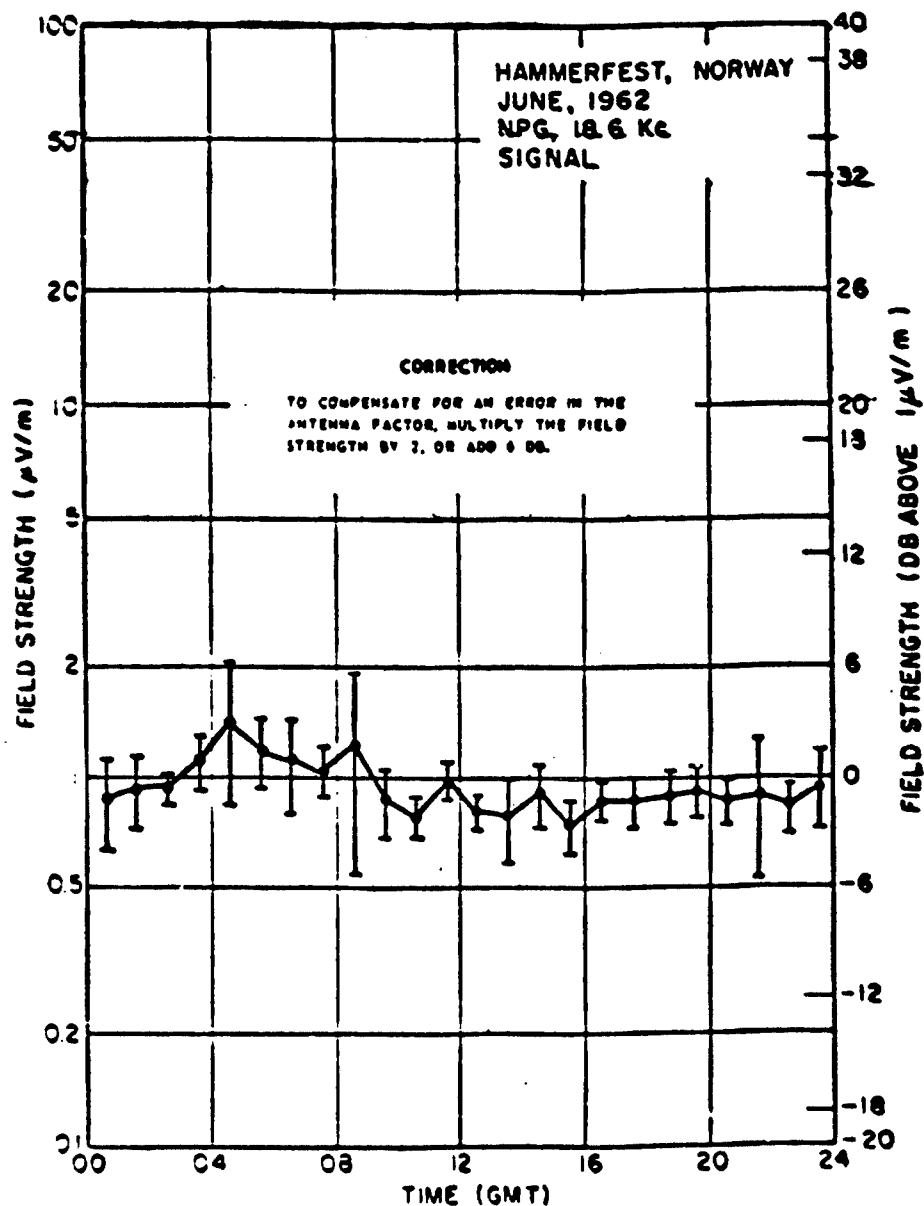


Figure 10

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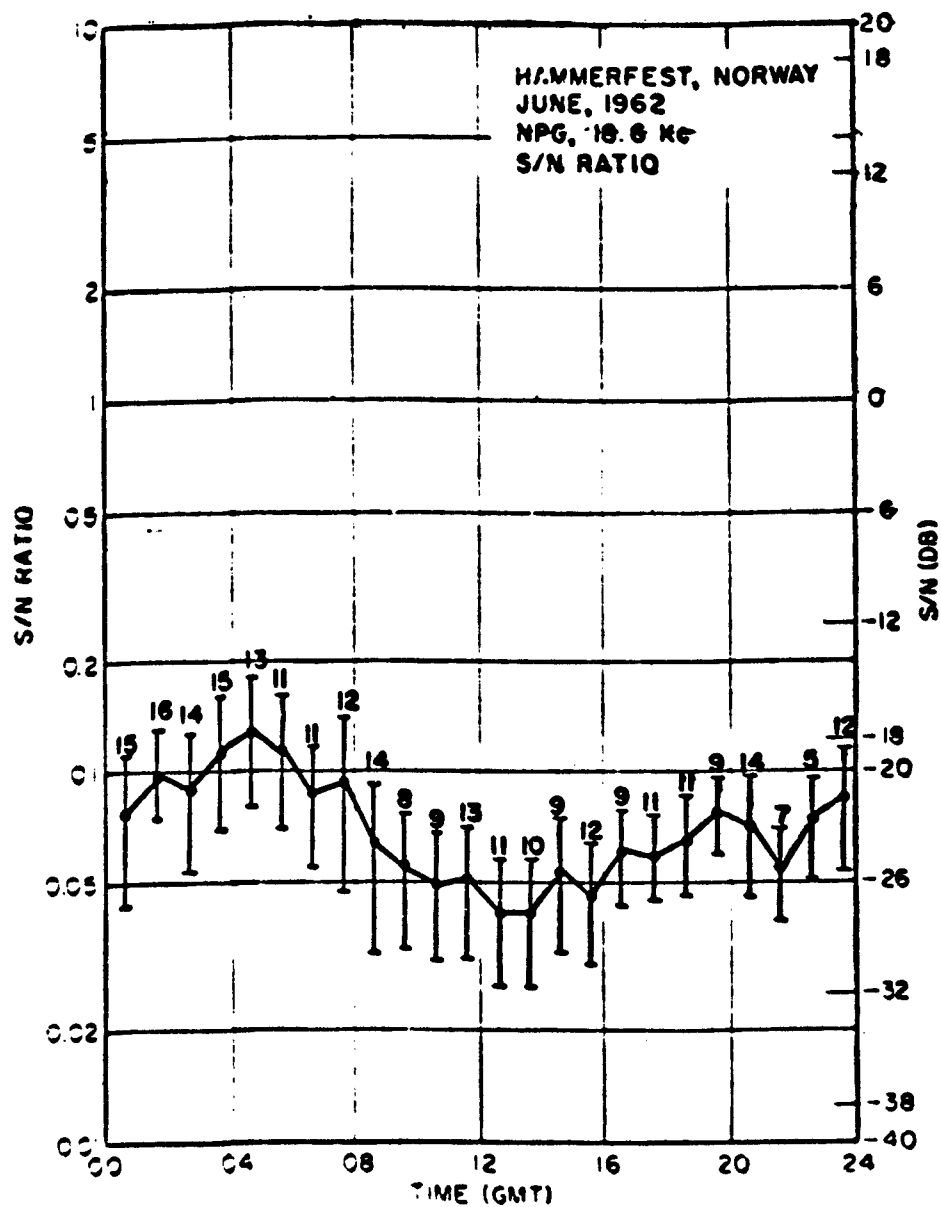


Figure 11

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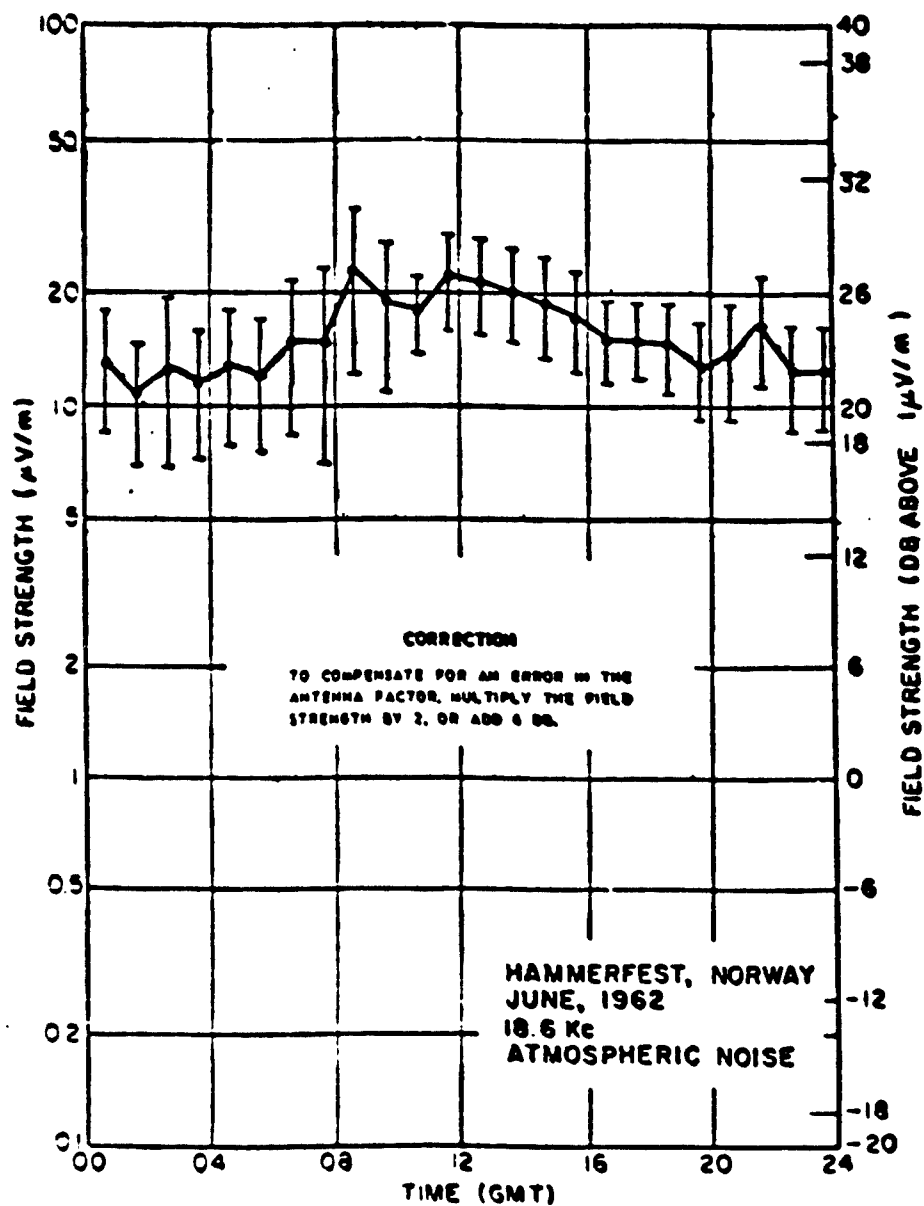


Figure 12

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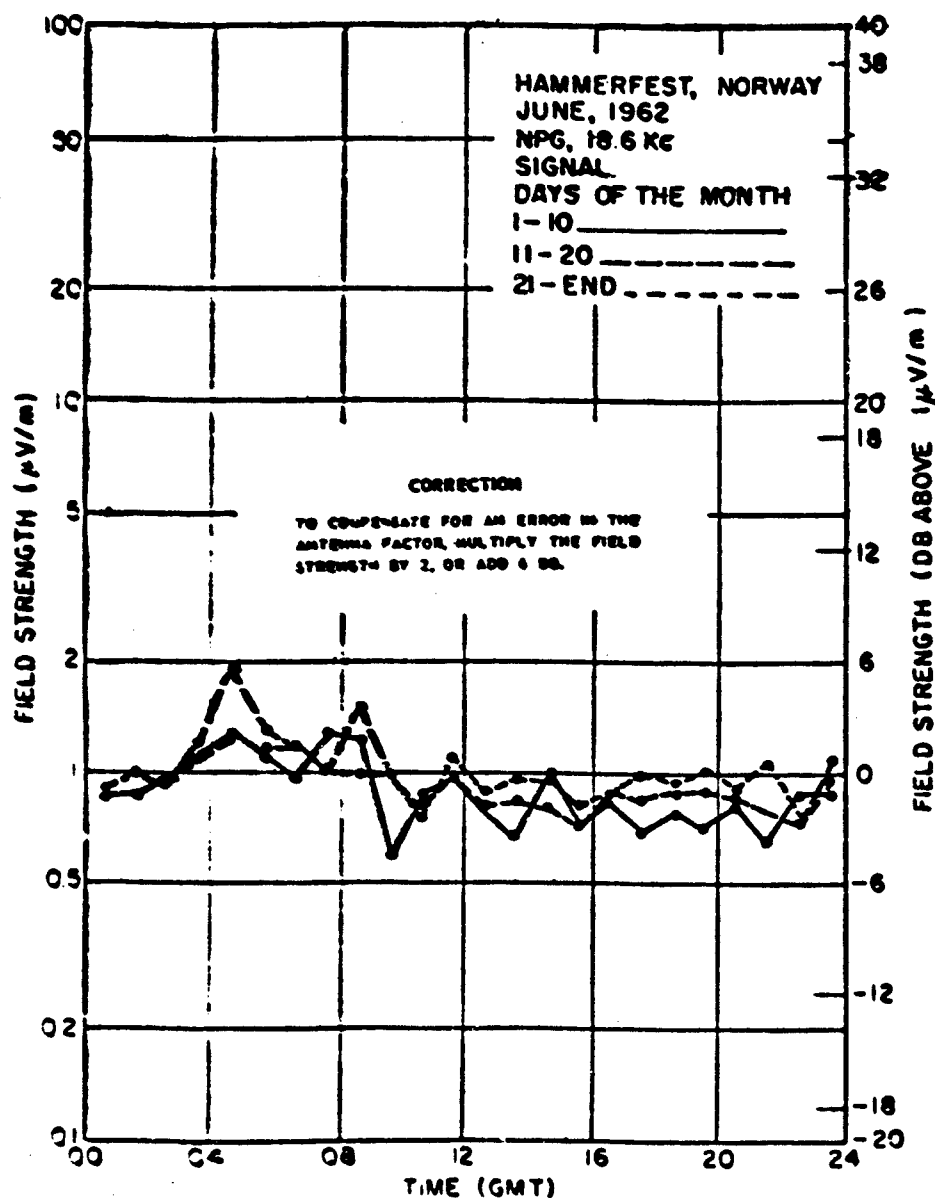


Figure 13

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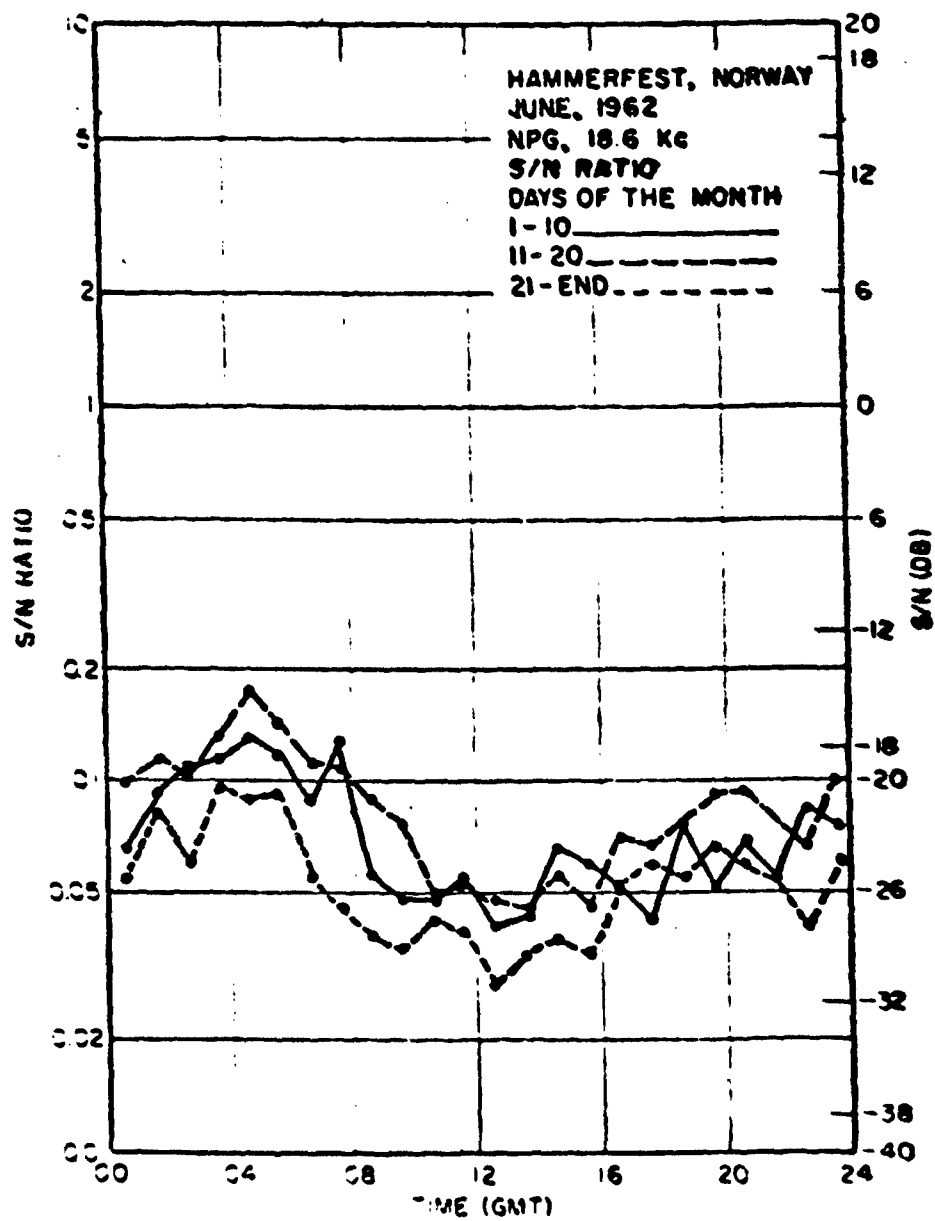


Figure 14

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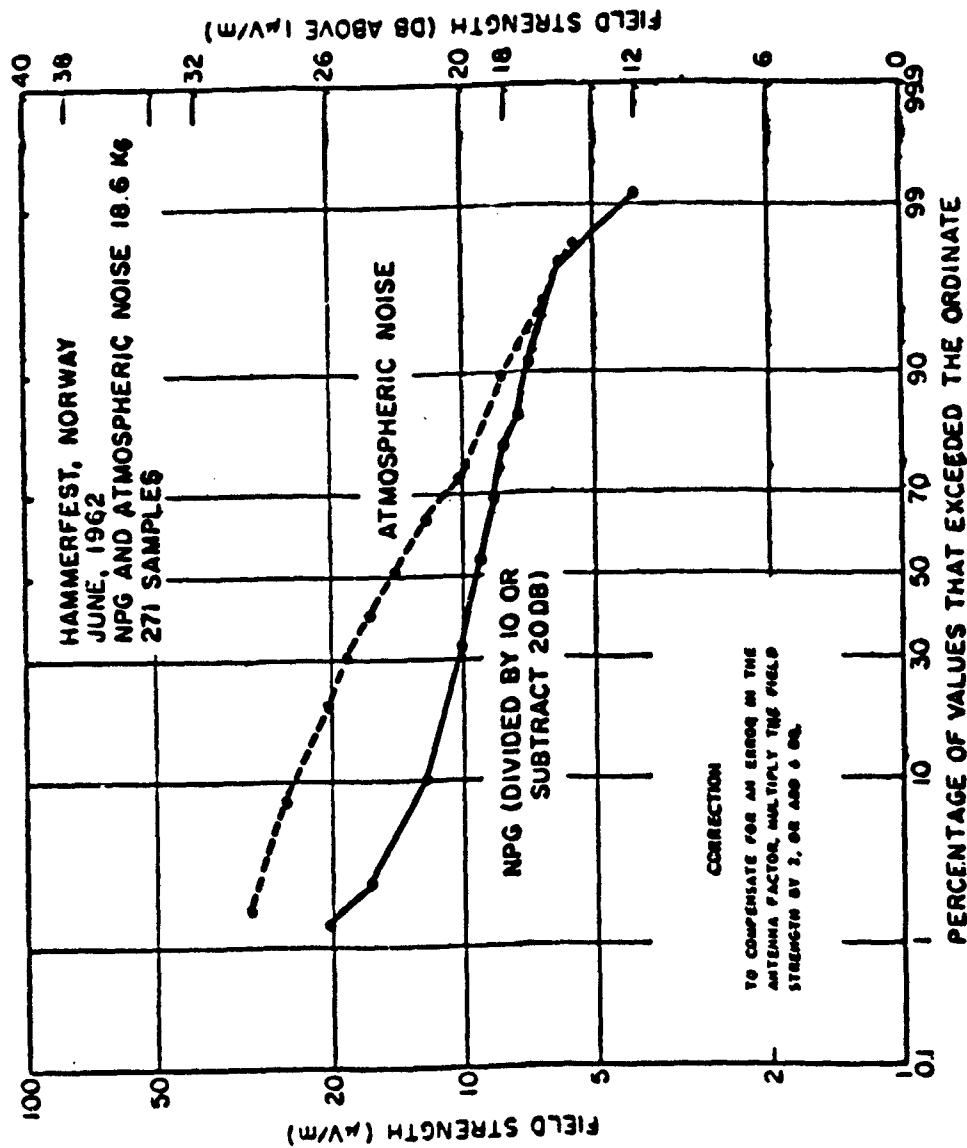


Figure 15

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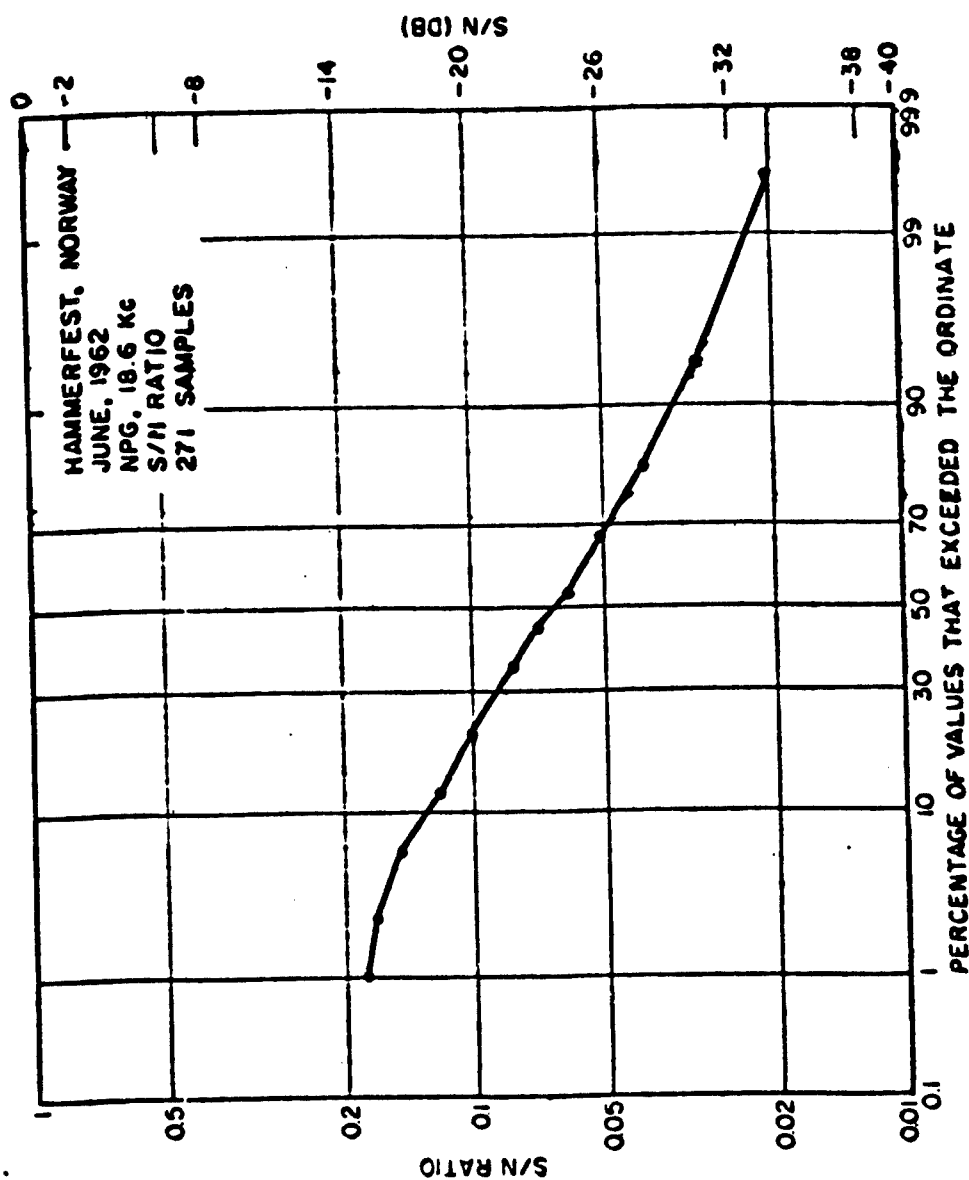


Figure 18

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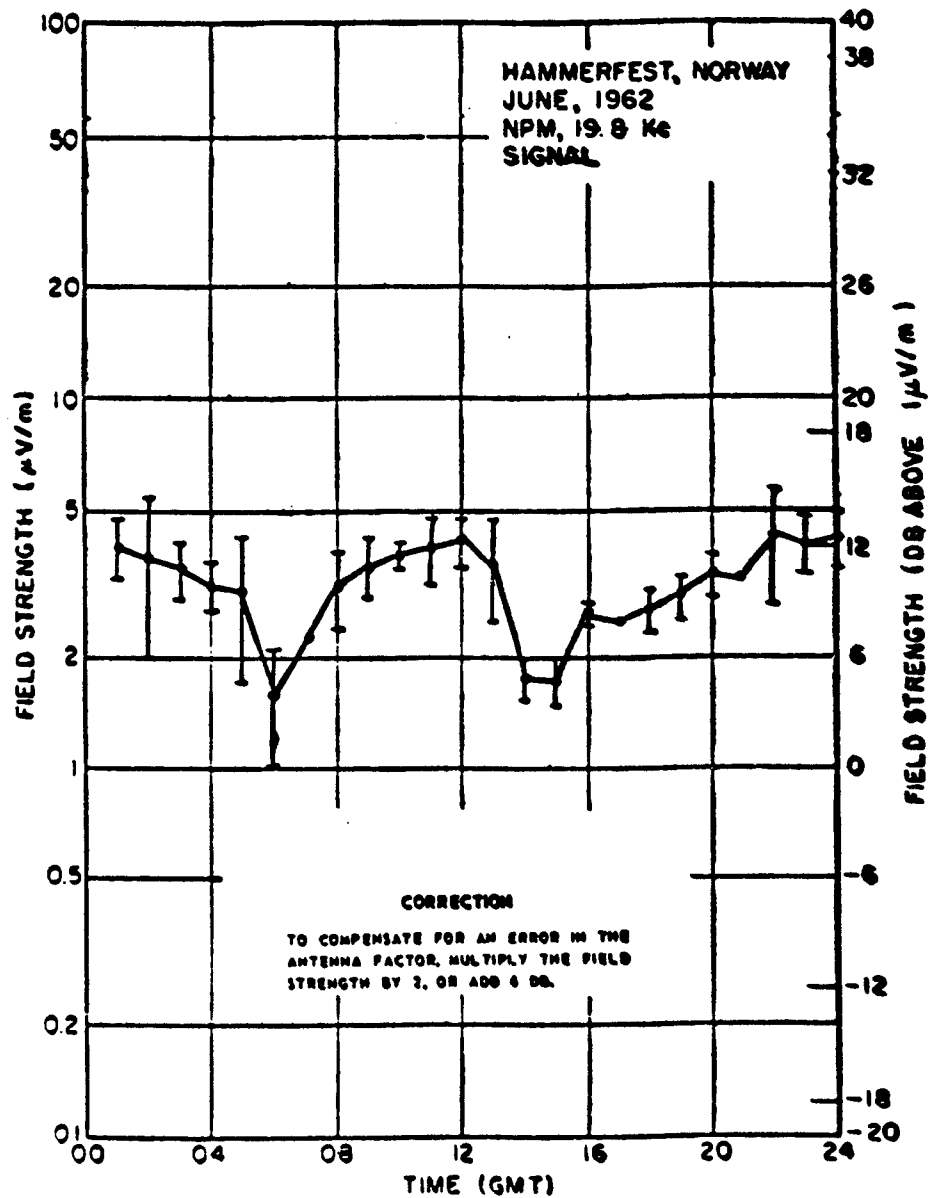


Figure 17

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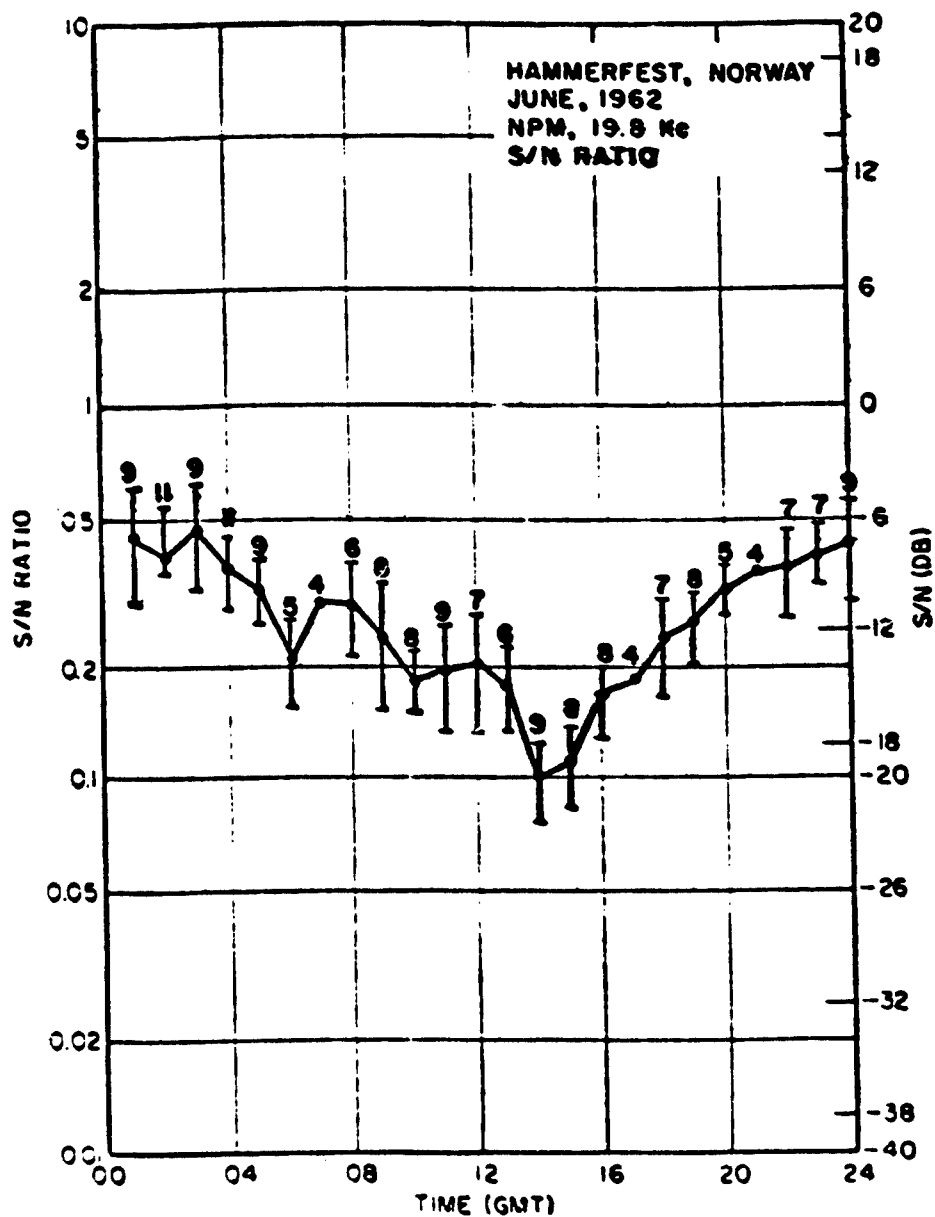


Figure 18

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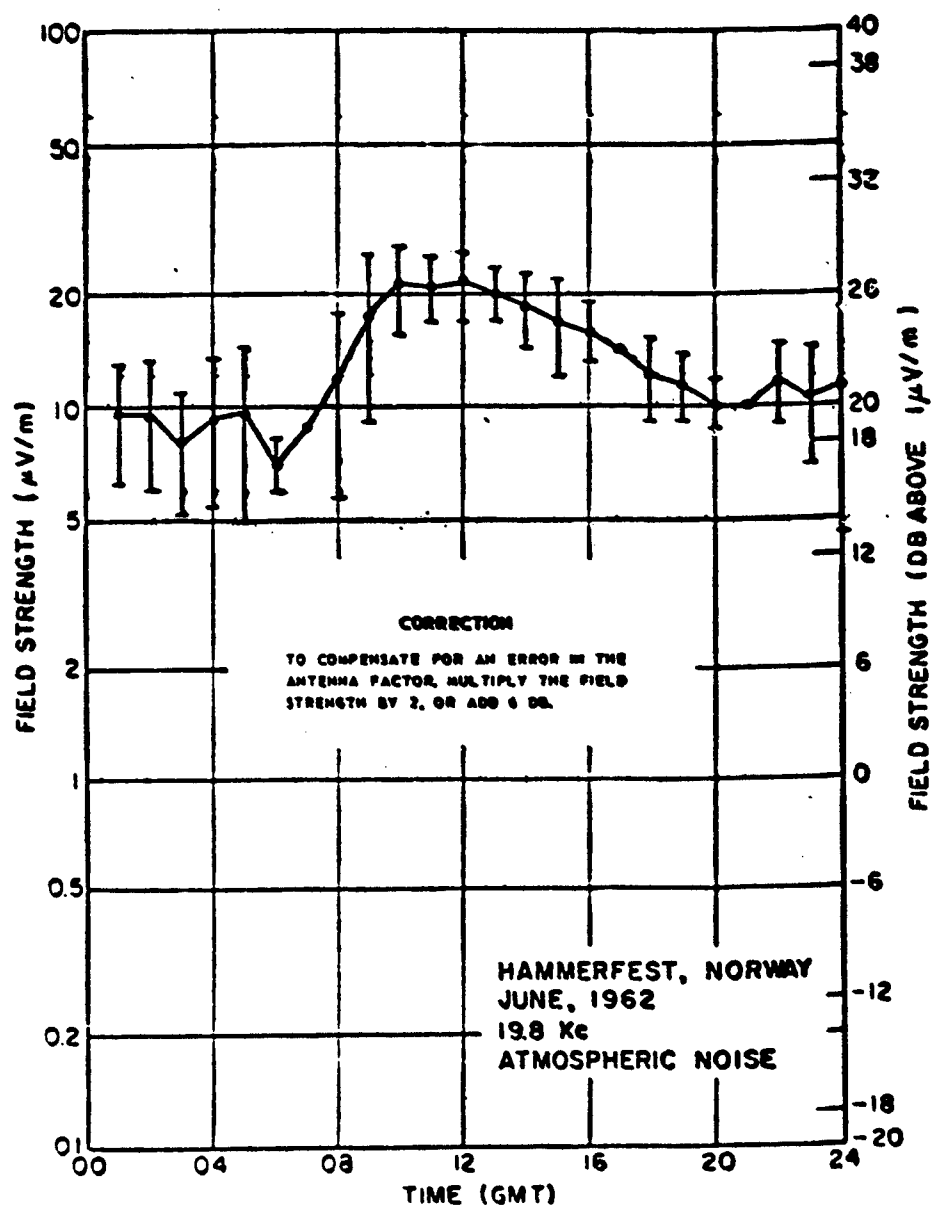


Figure 10

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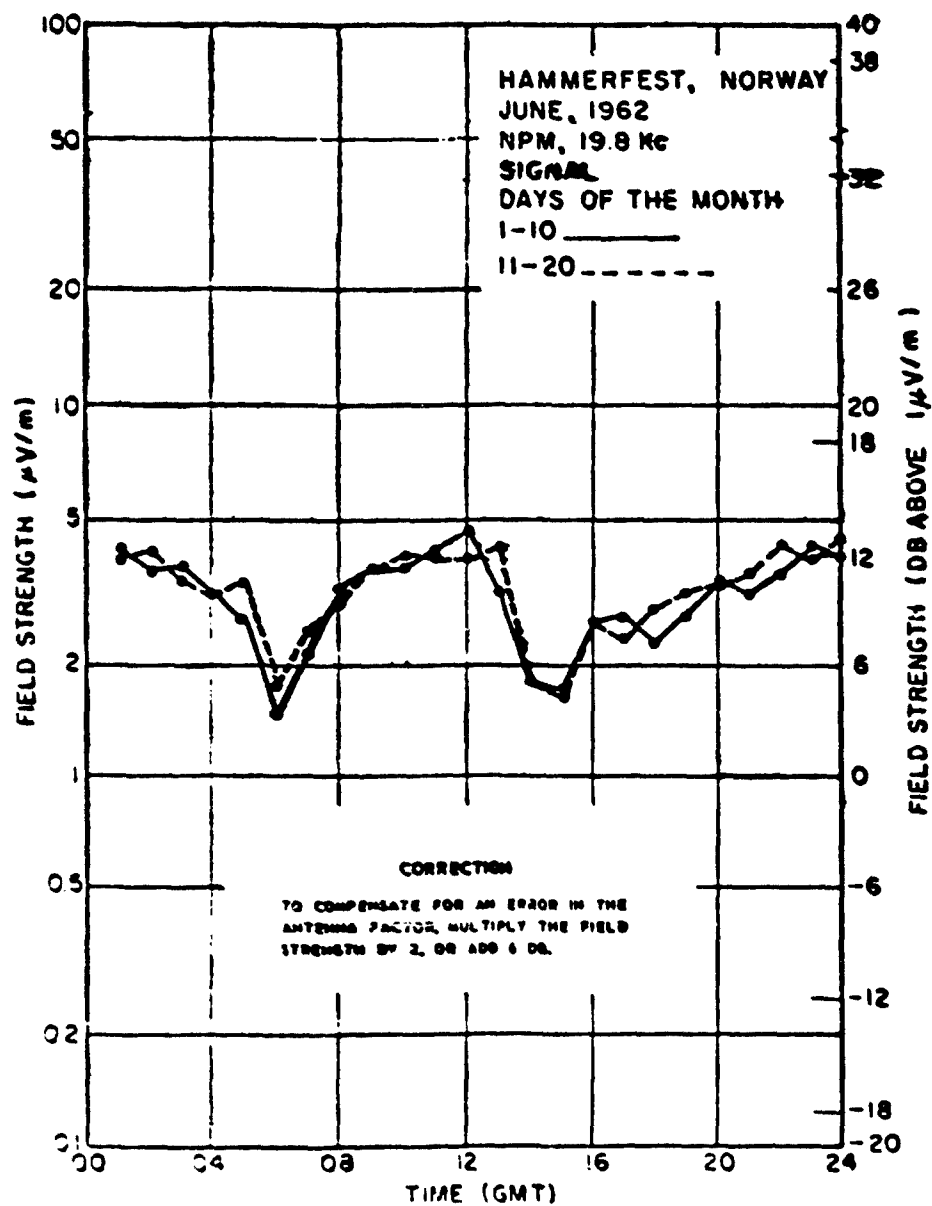


Figure 20

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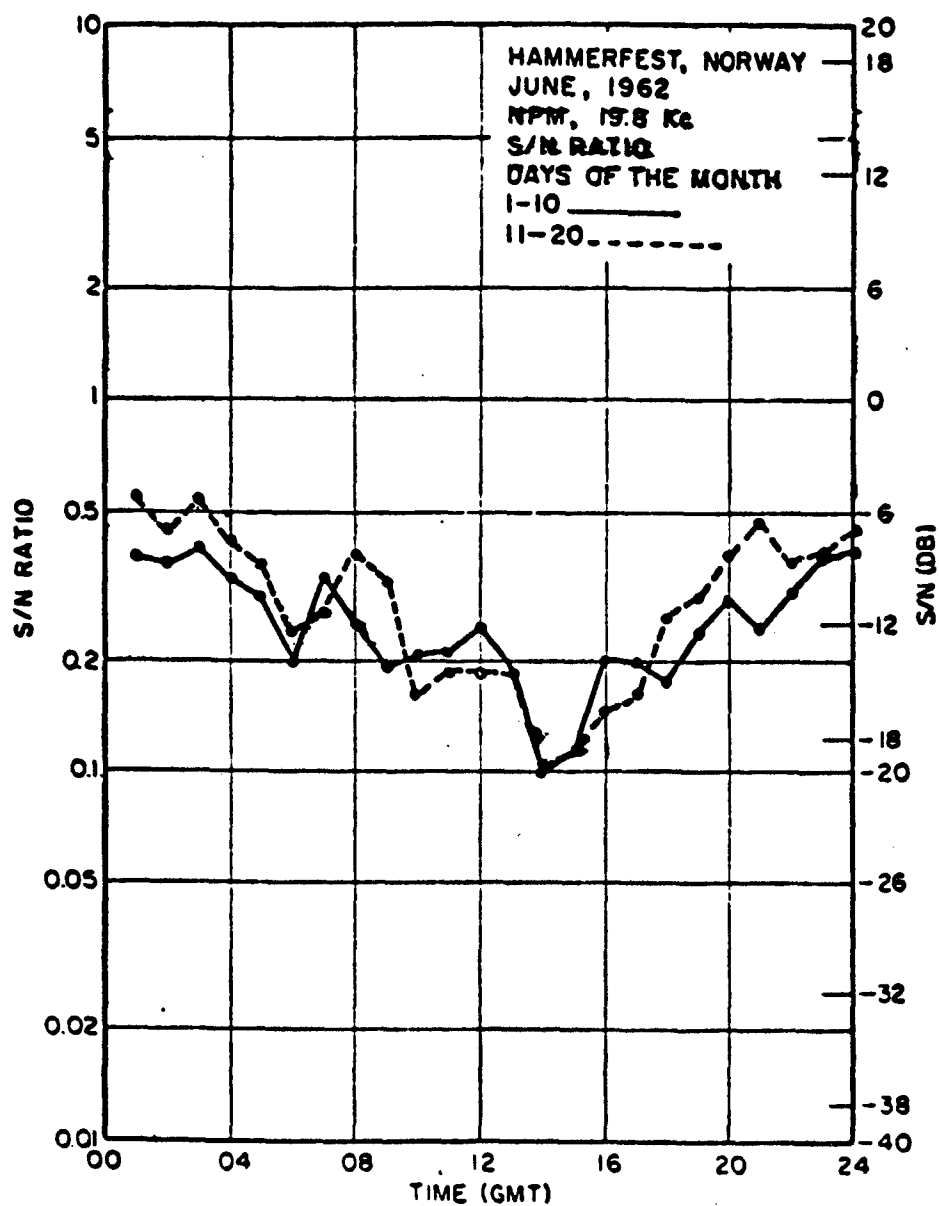


Figure 21

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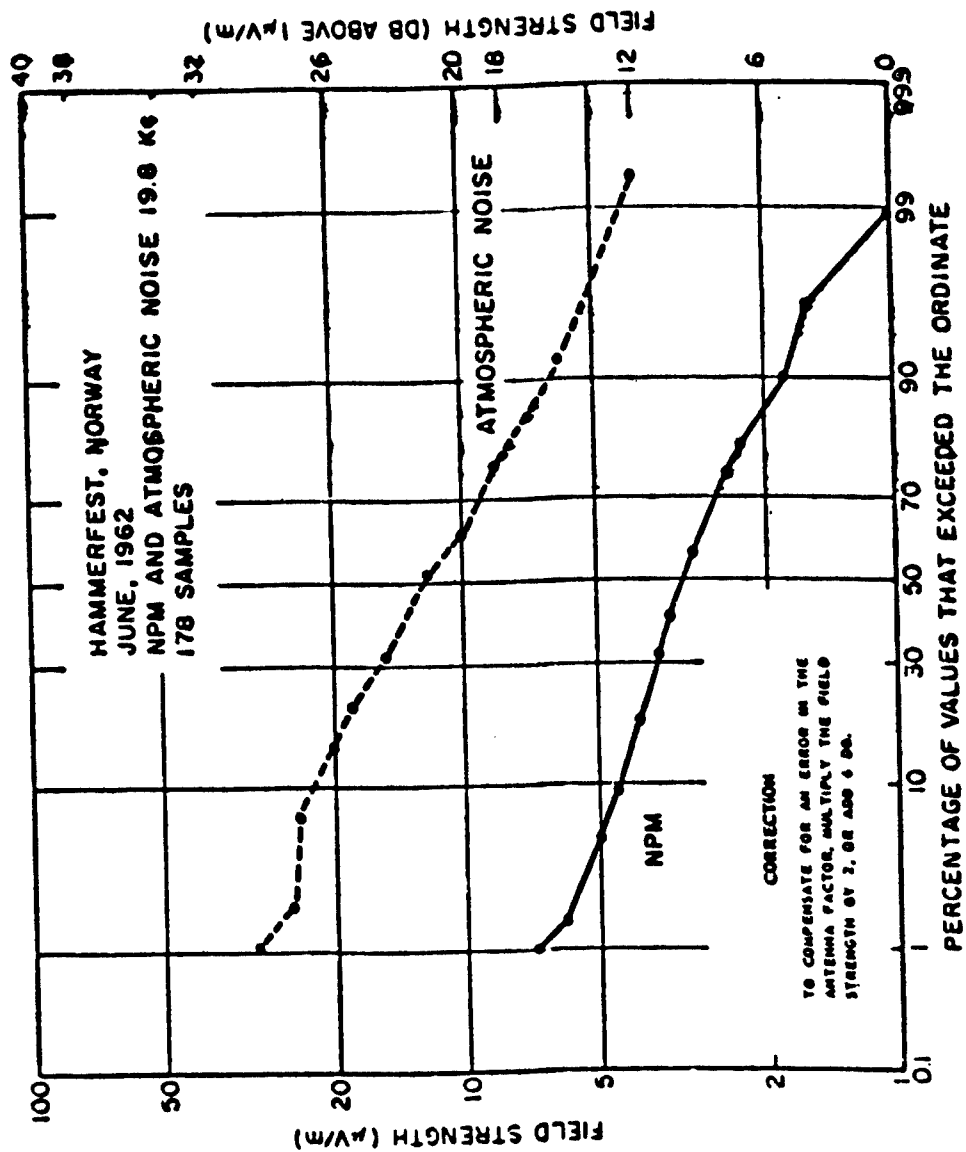


Figure 22

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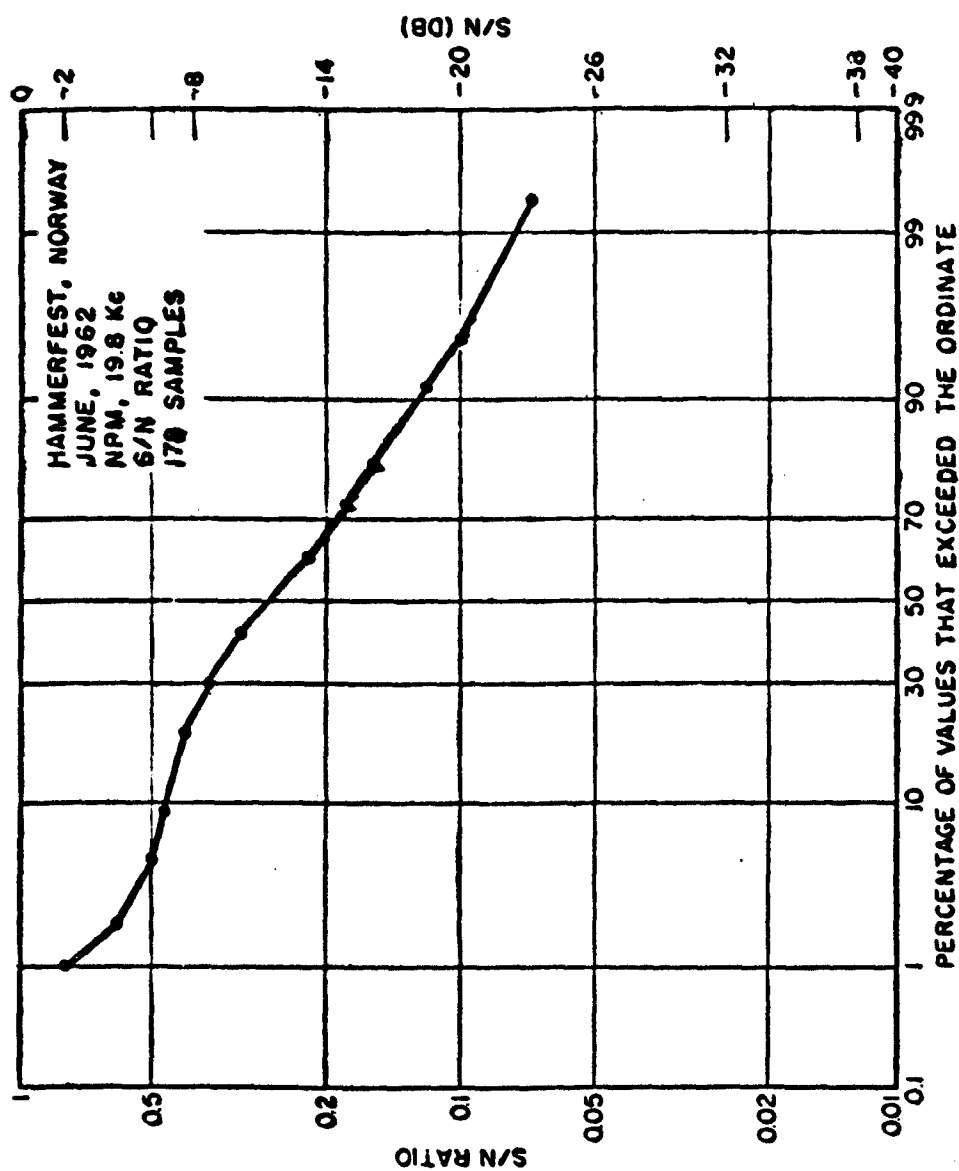


Figure 23

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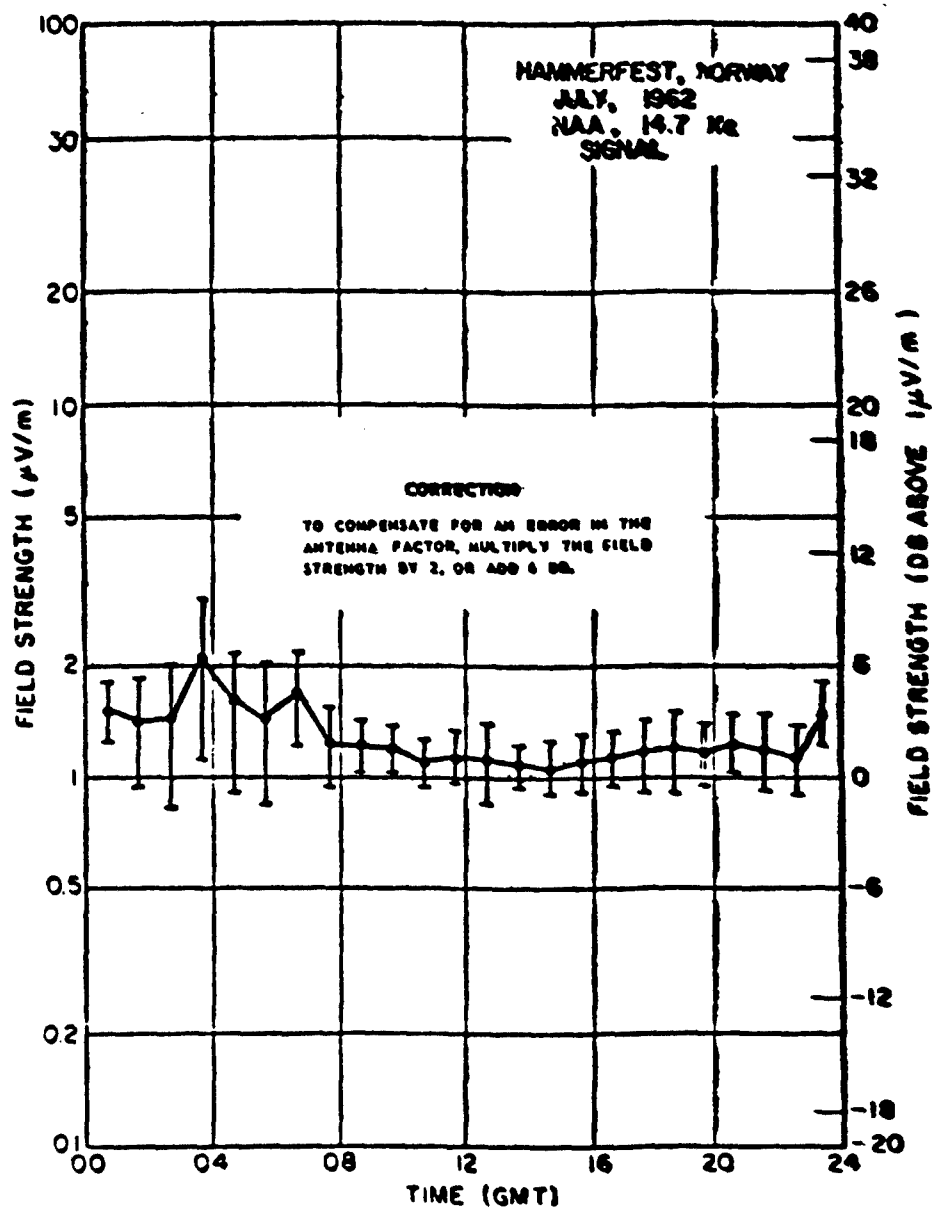


Figure 24

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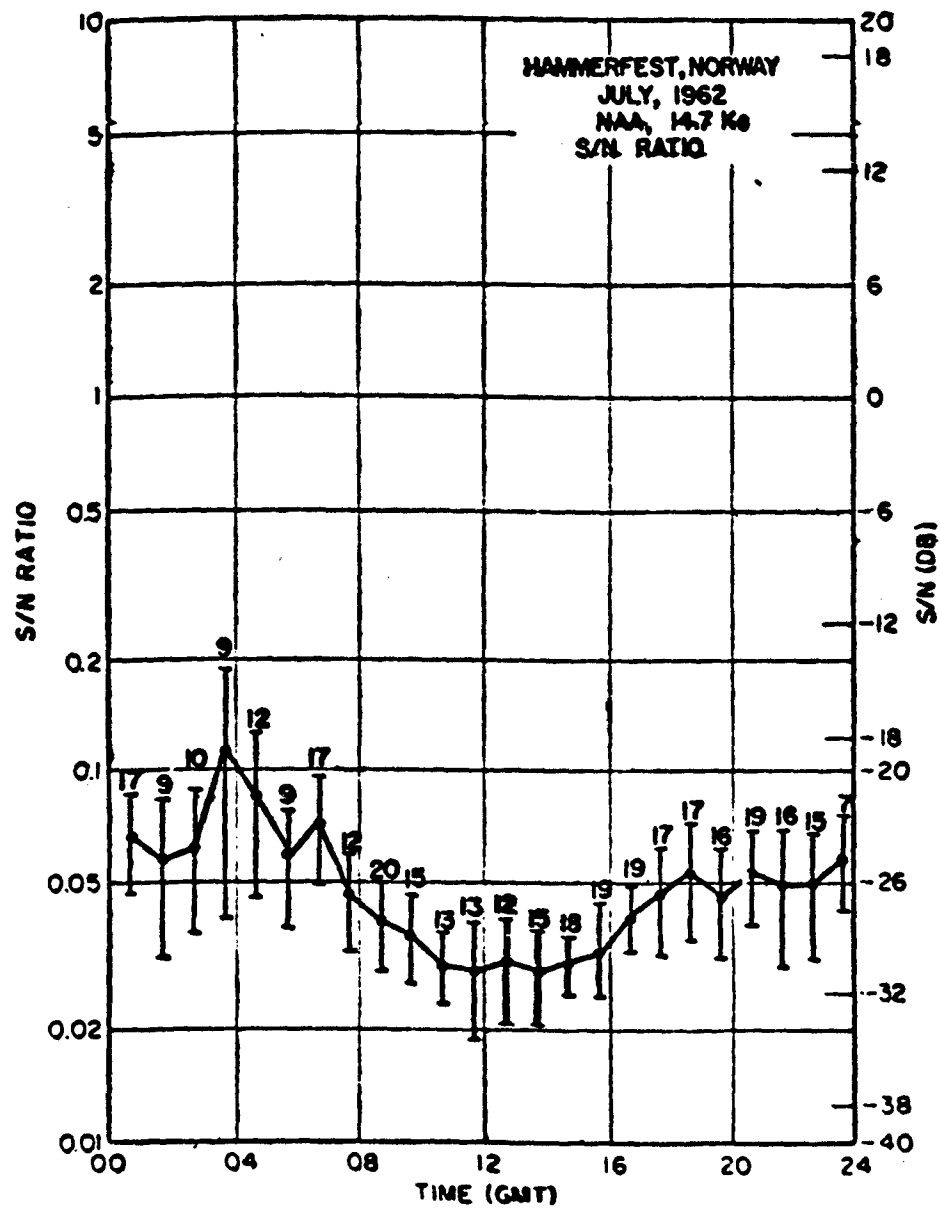


Figure 25

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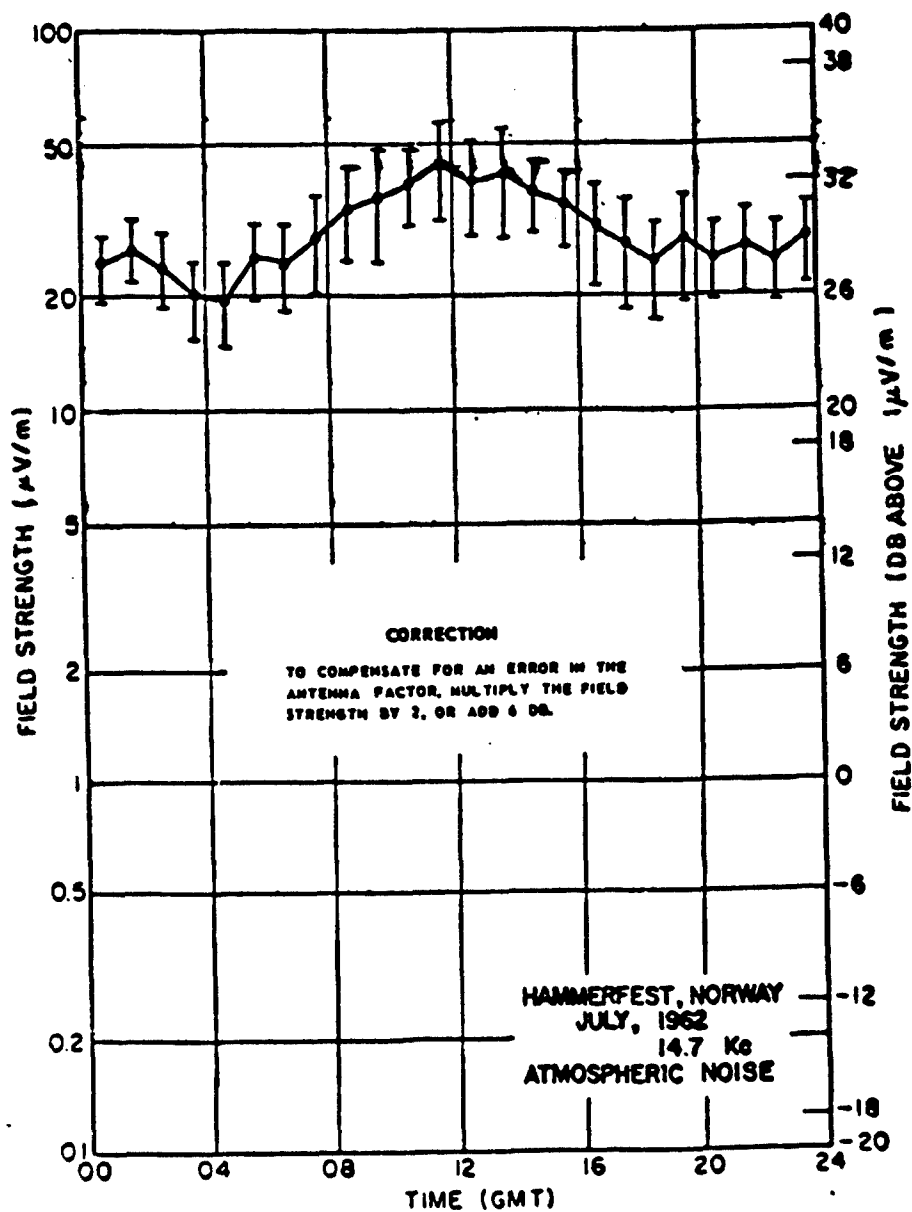


Figure 26

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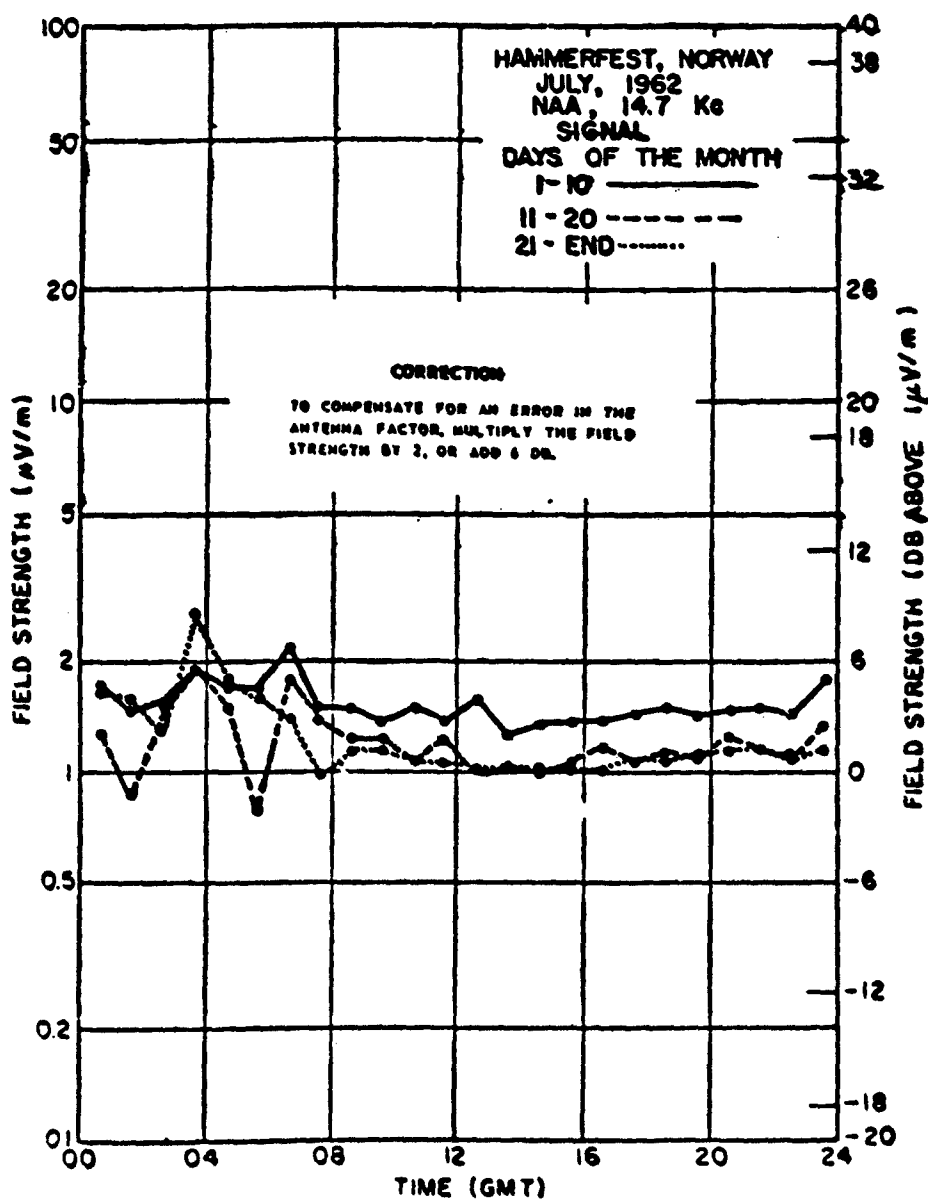


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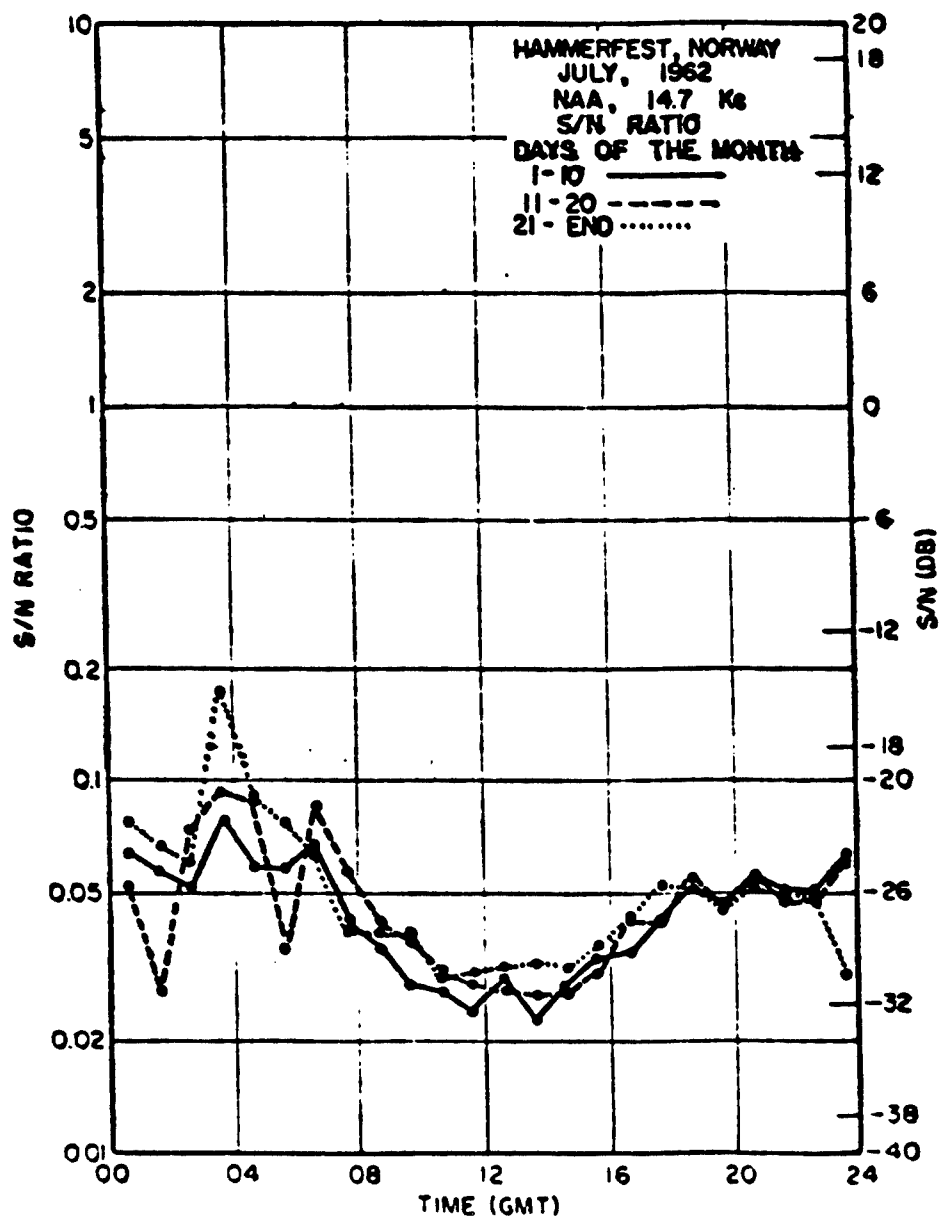


Figure 28

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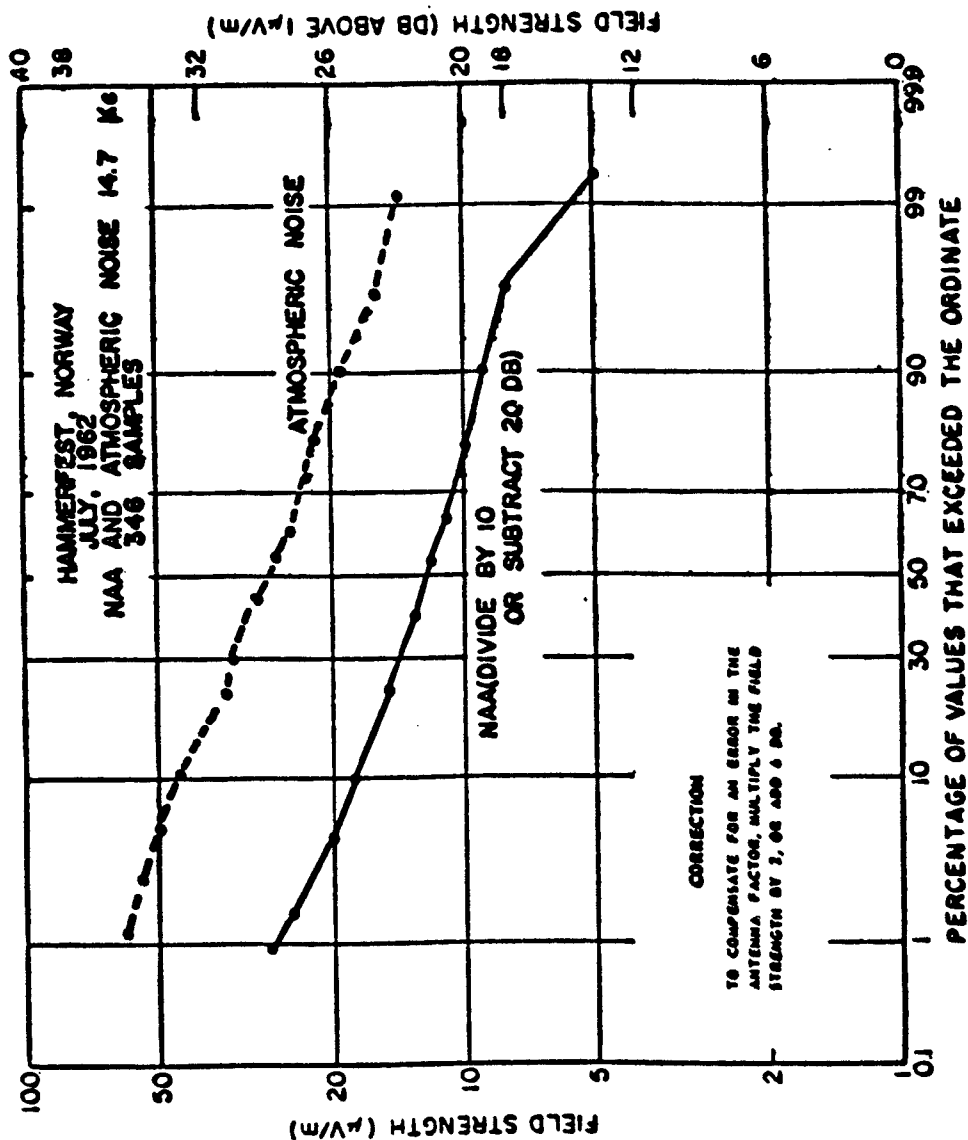


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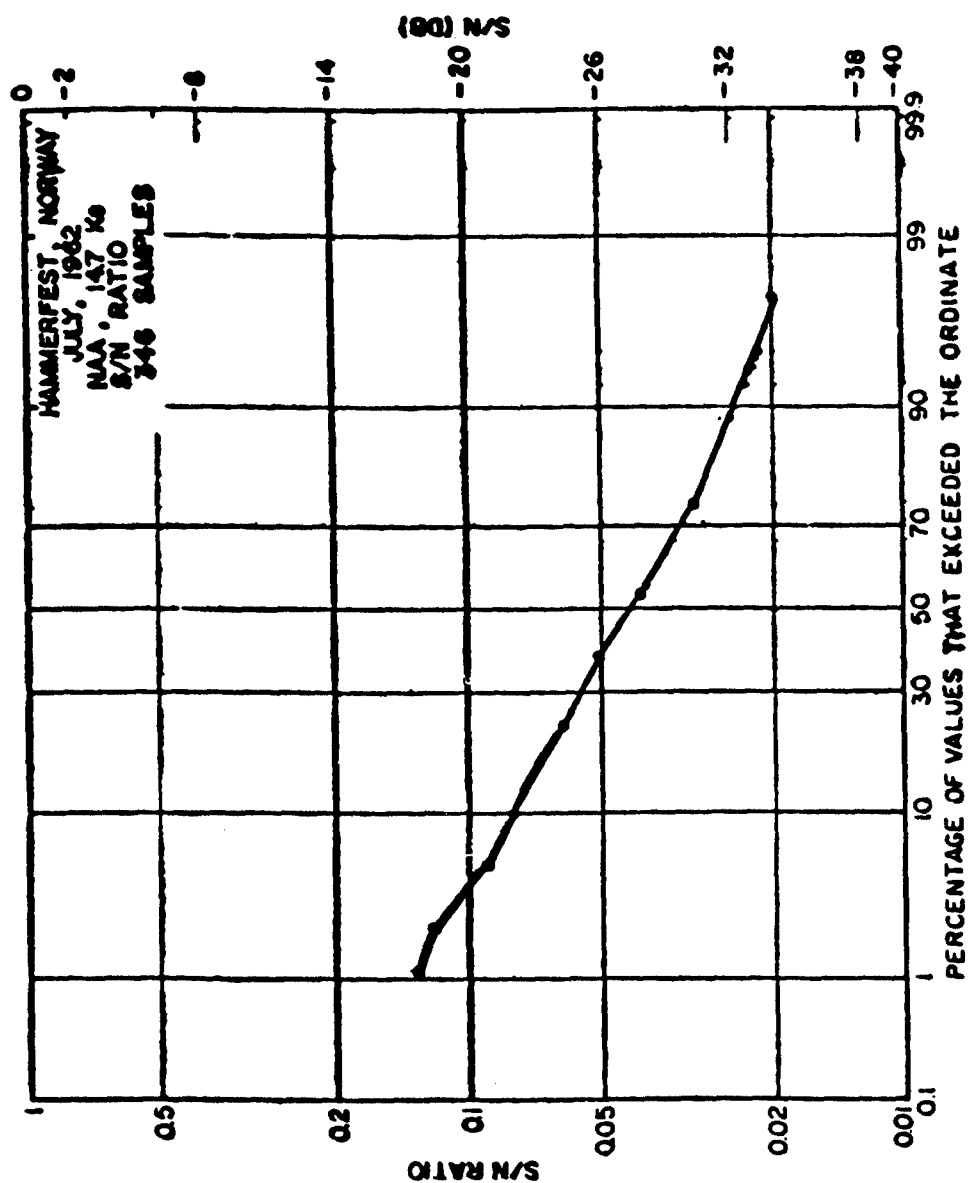


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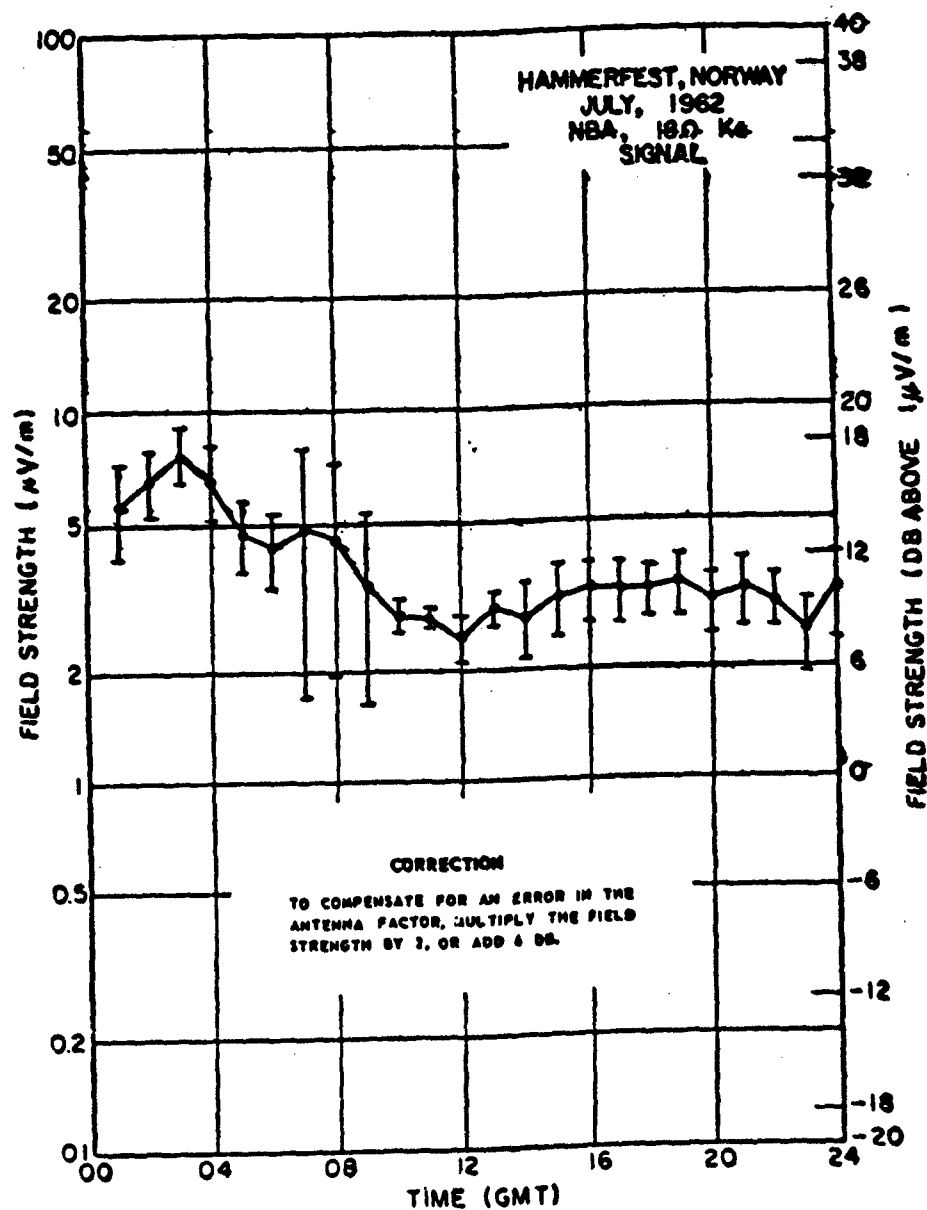


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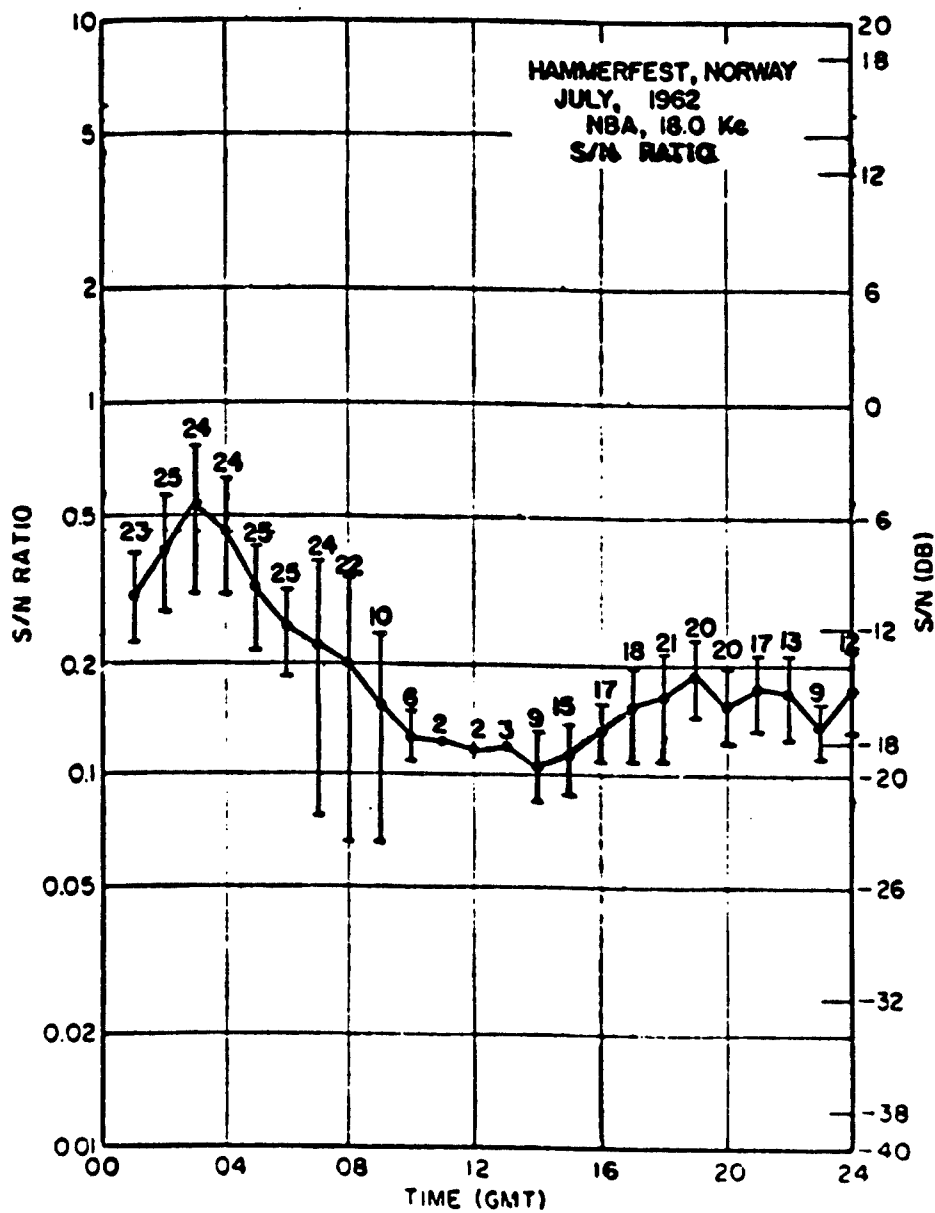


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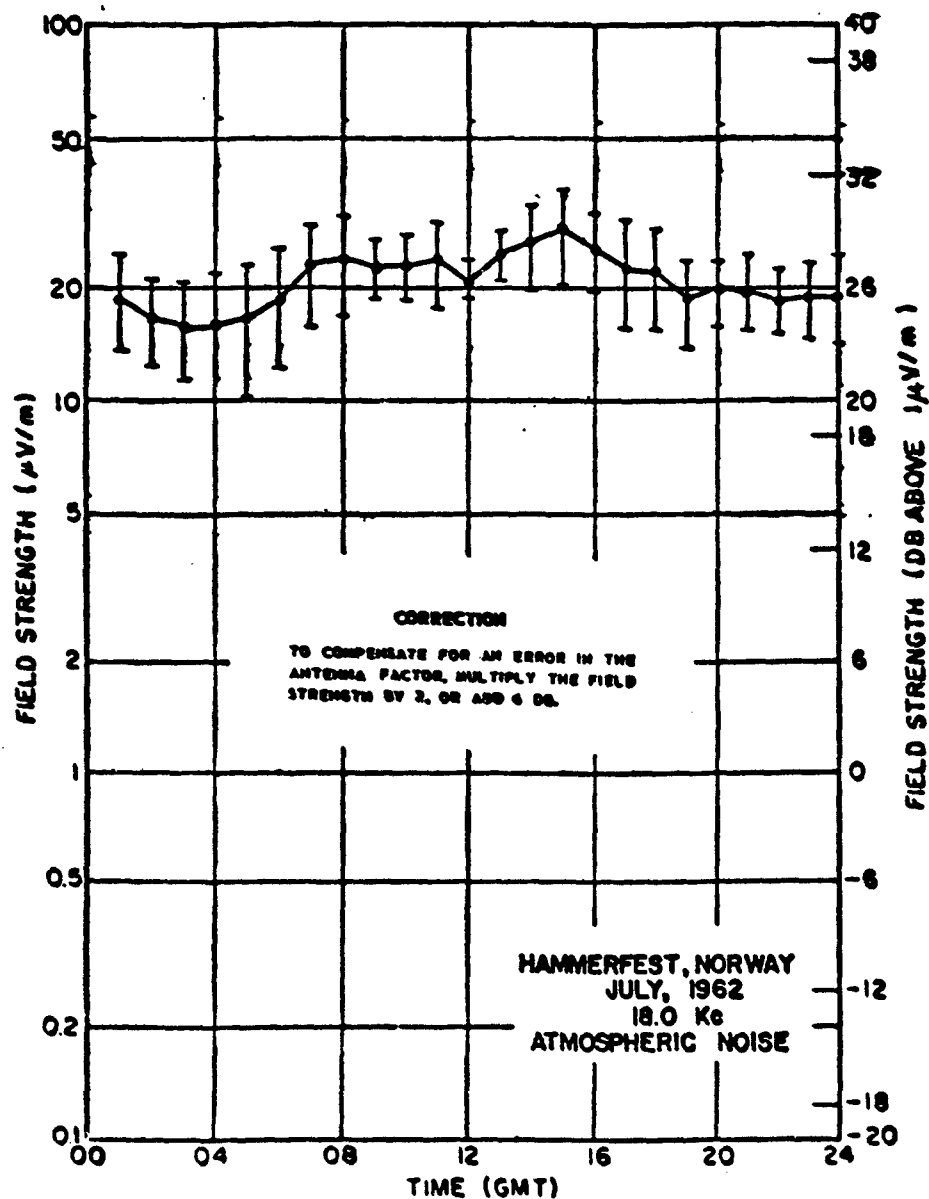


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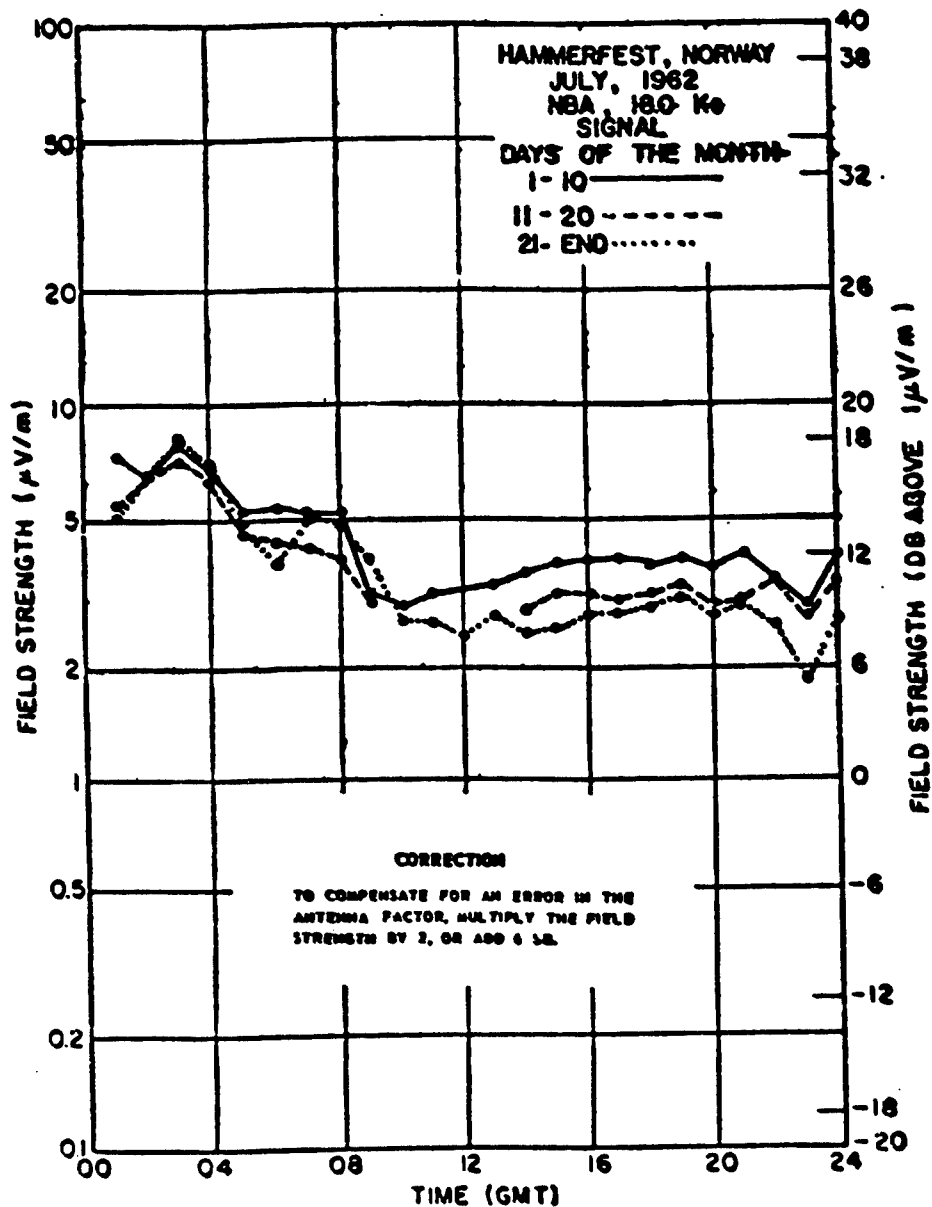


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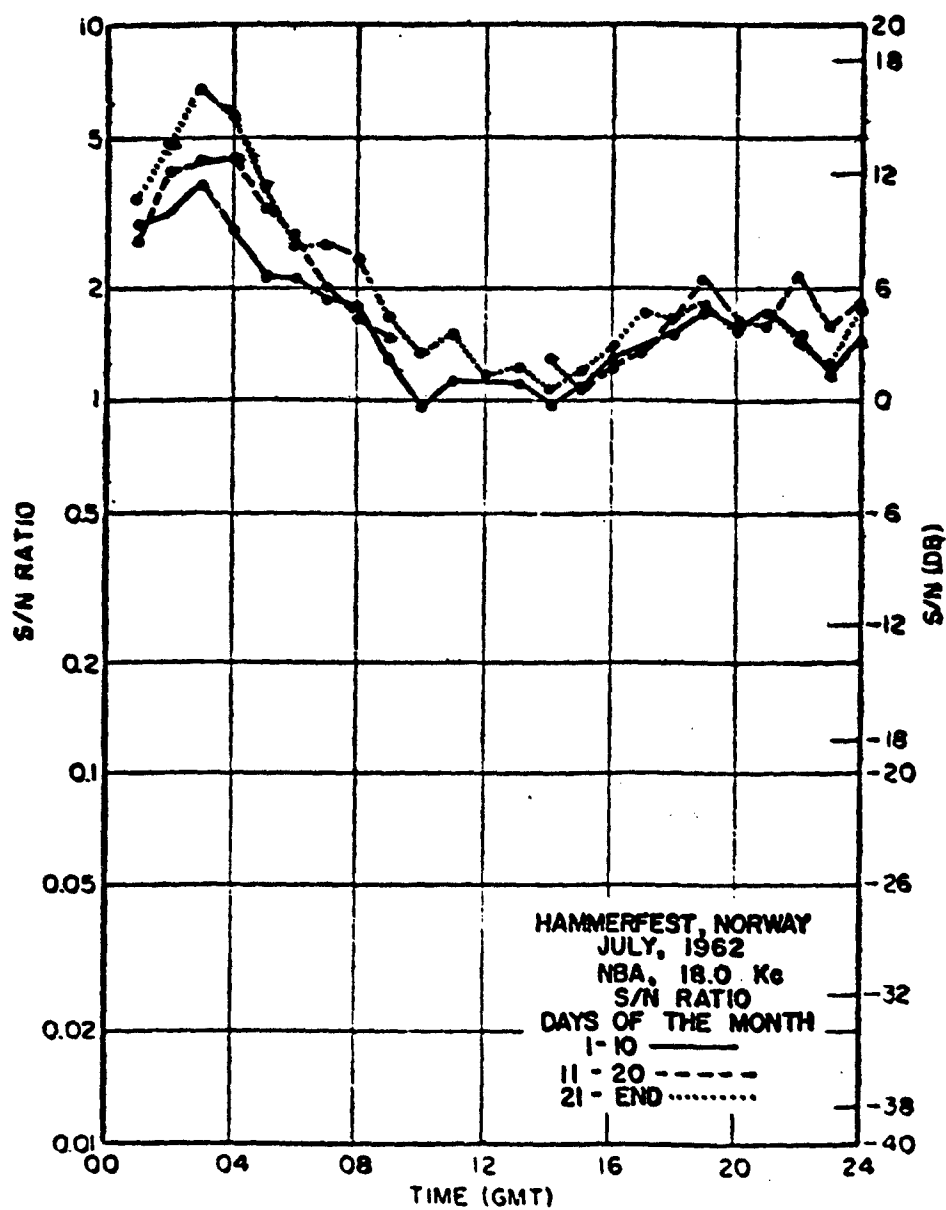


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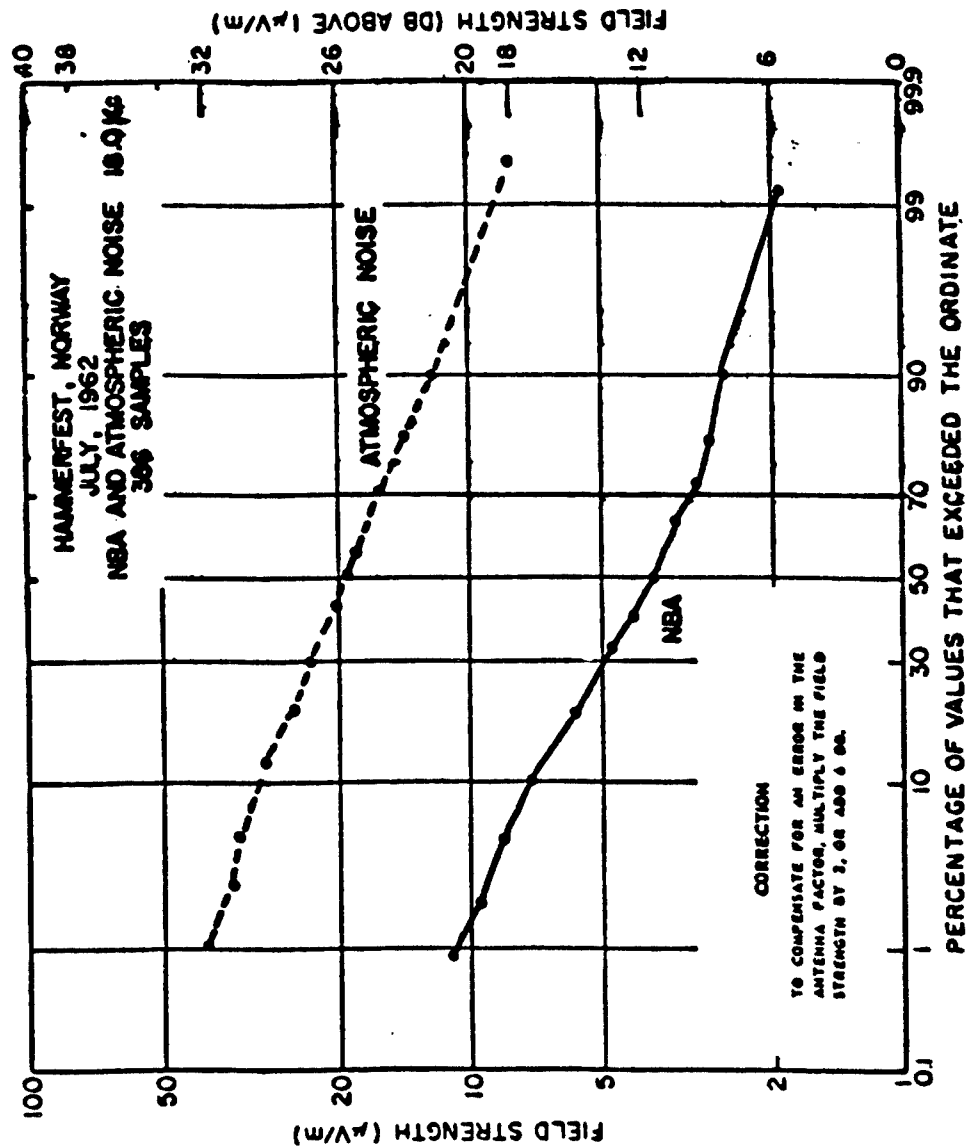


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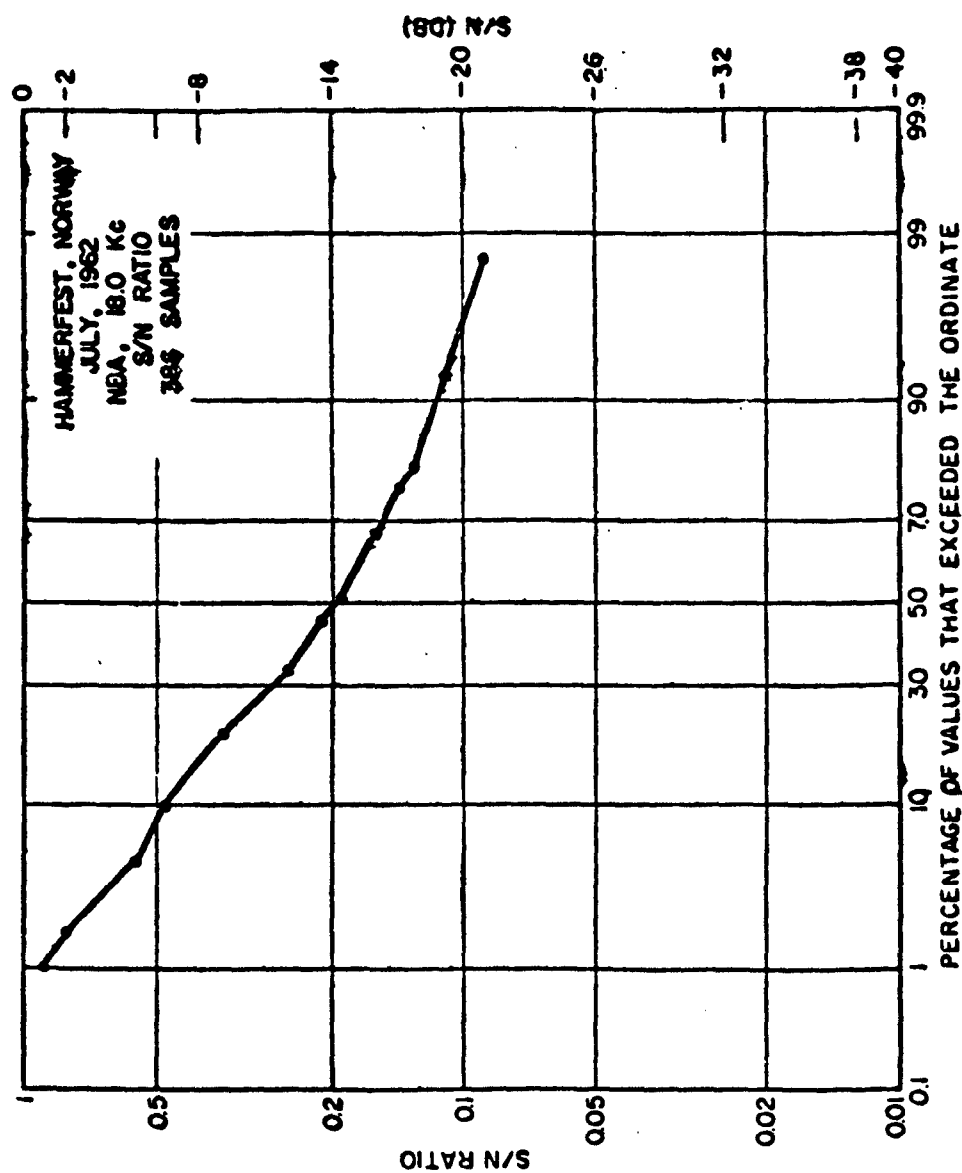


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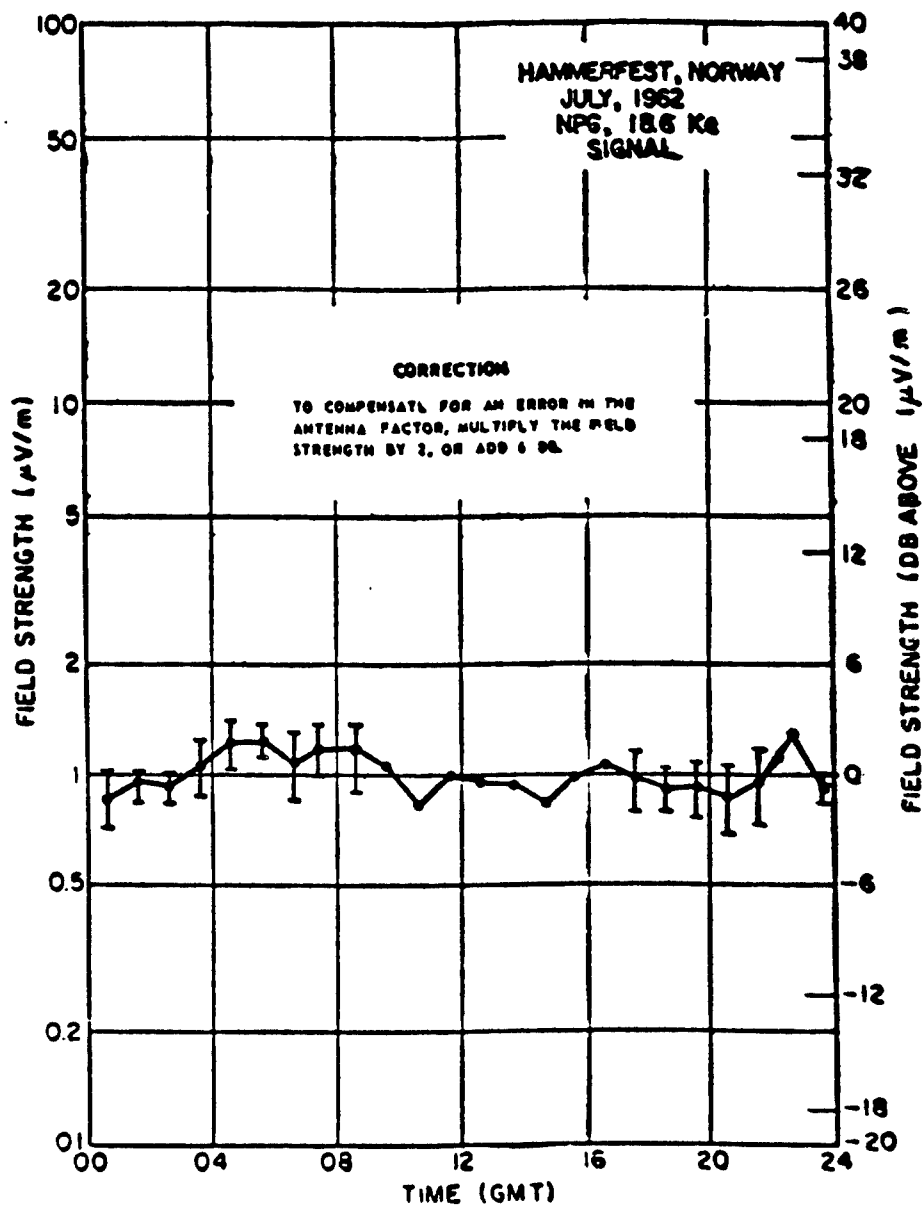


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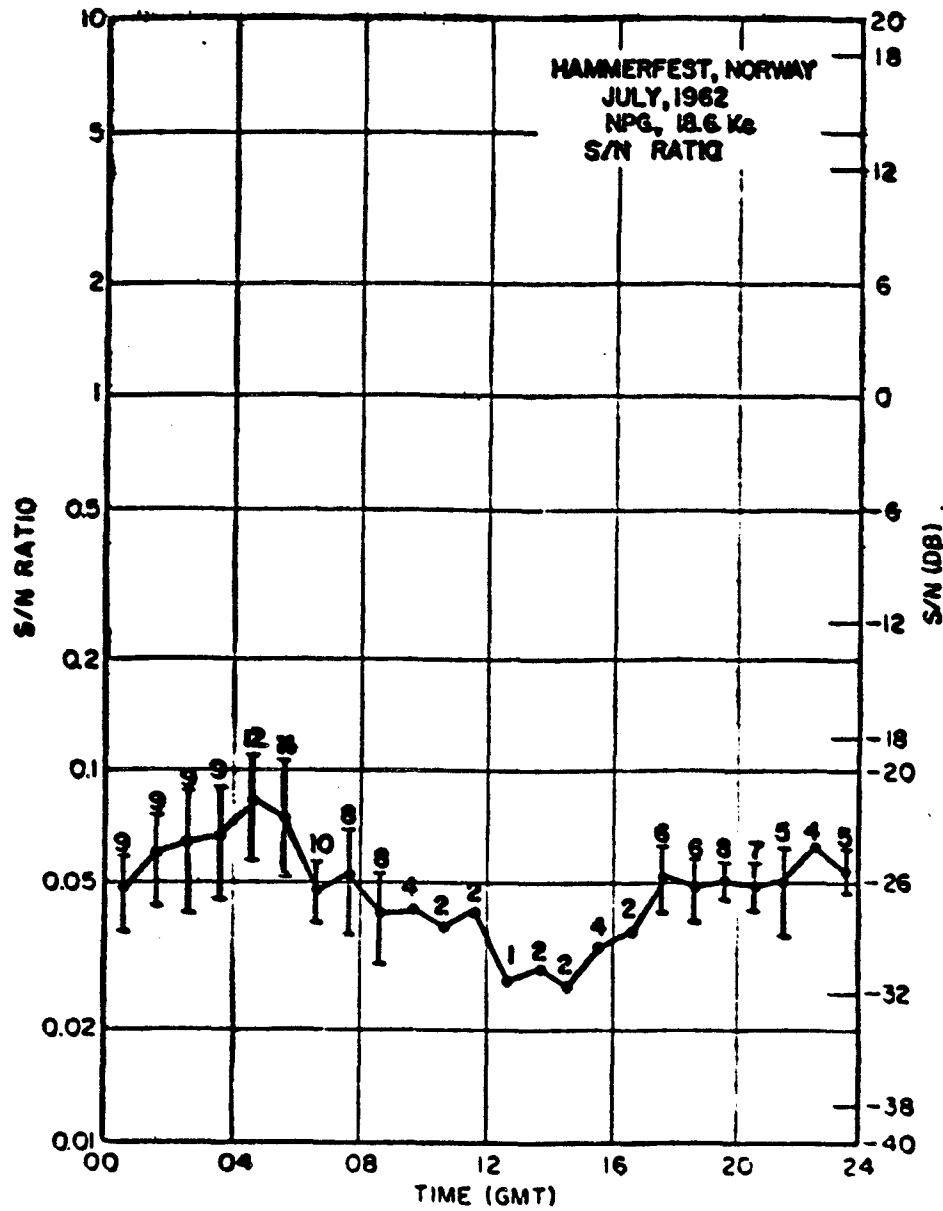


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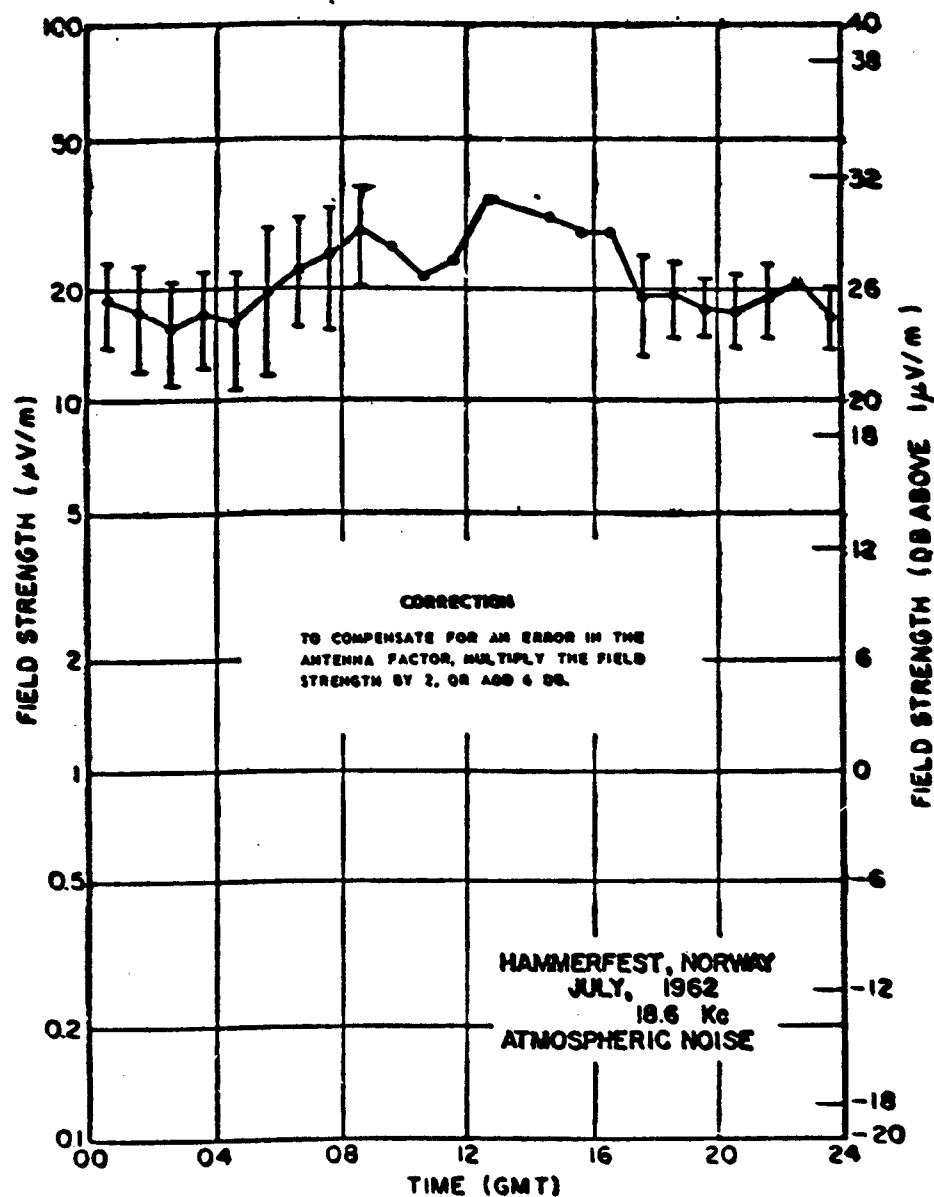


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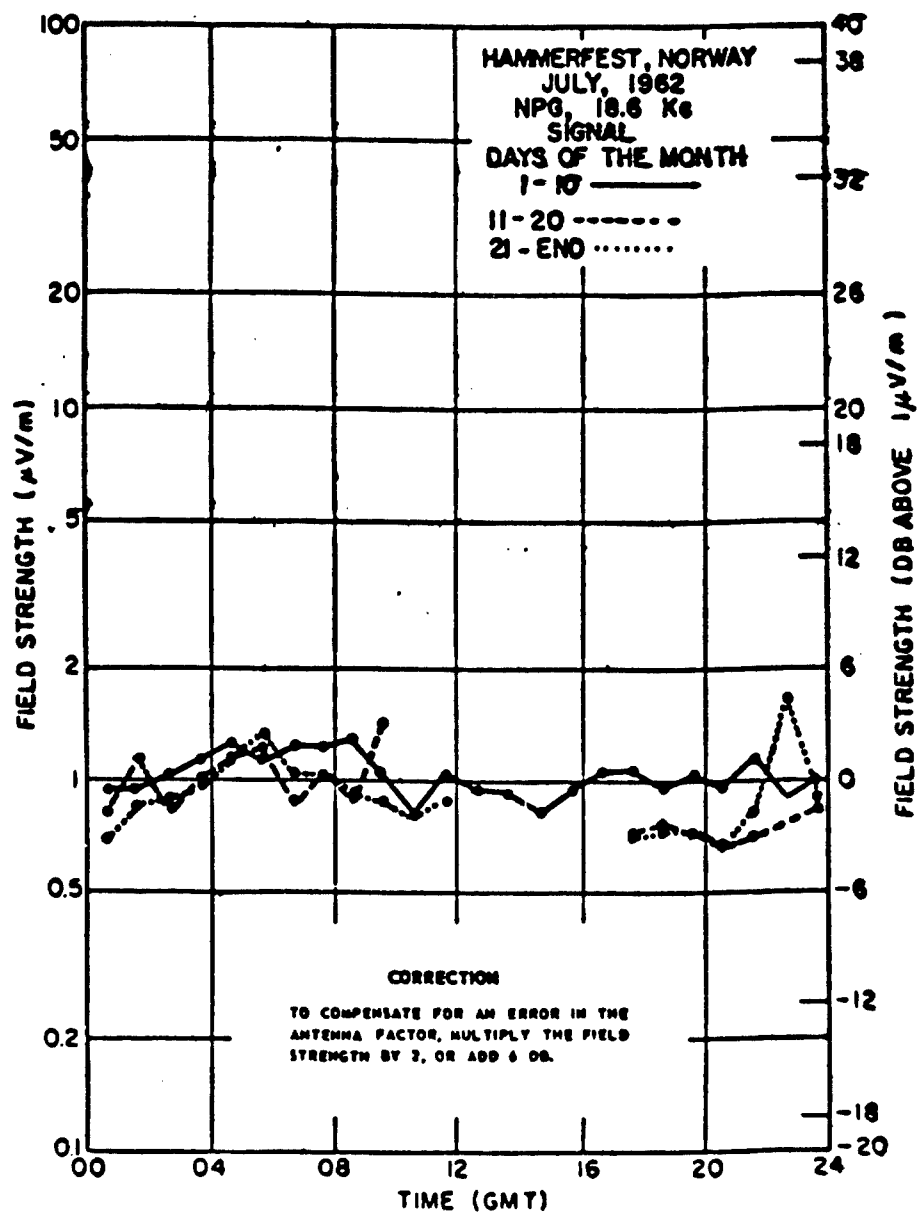


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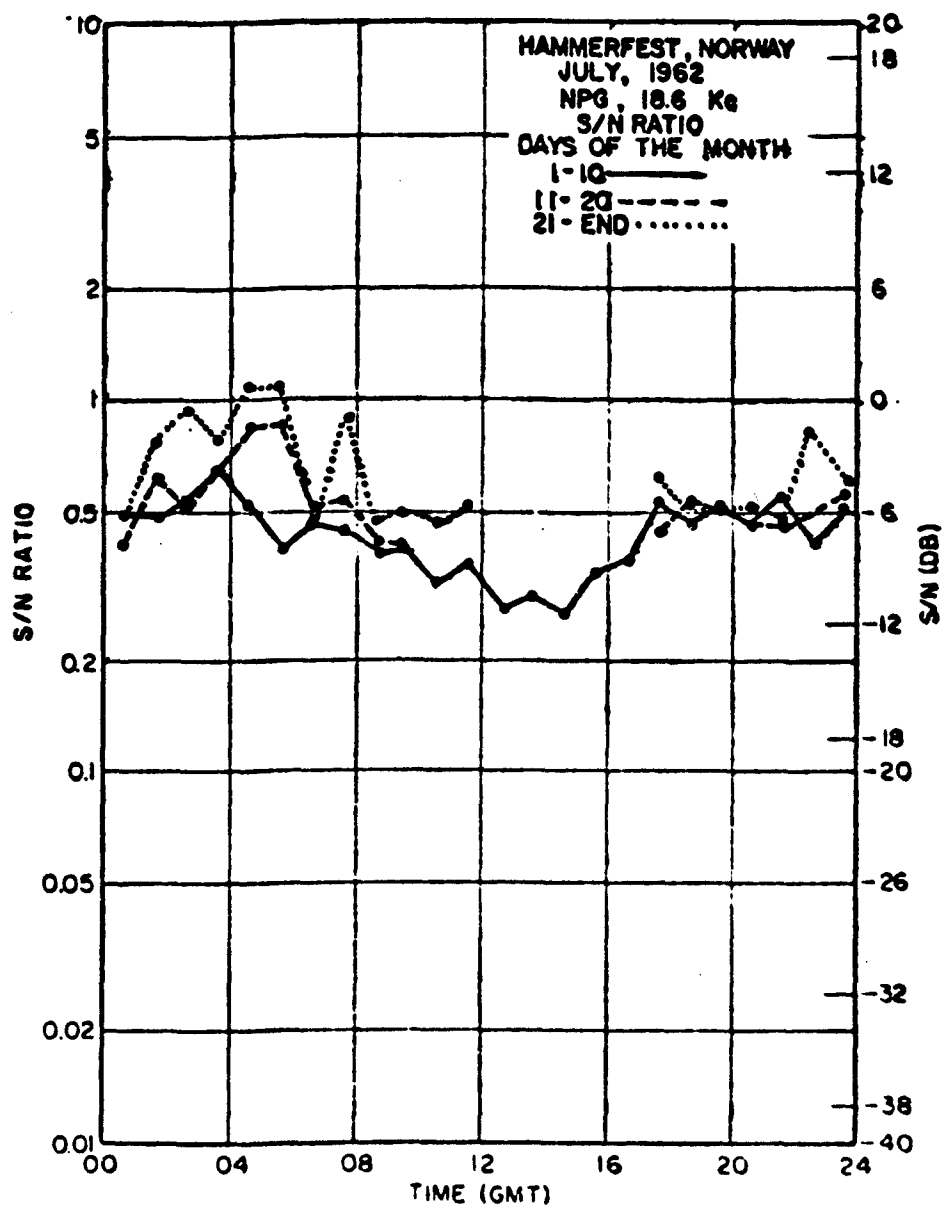


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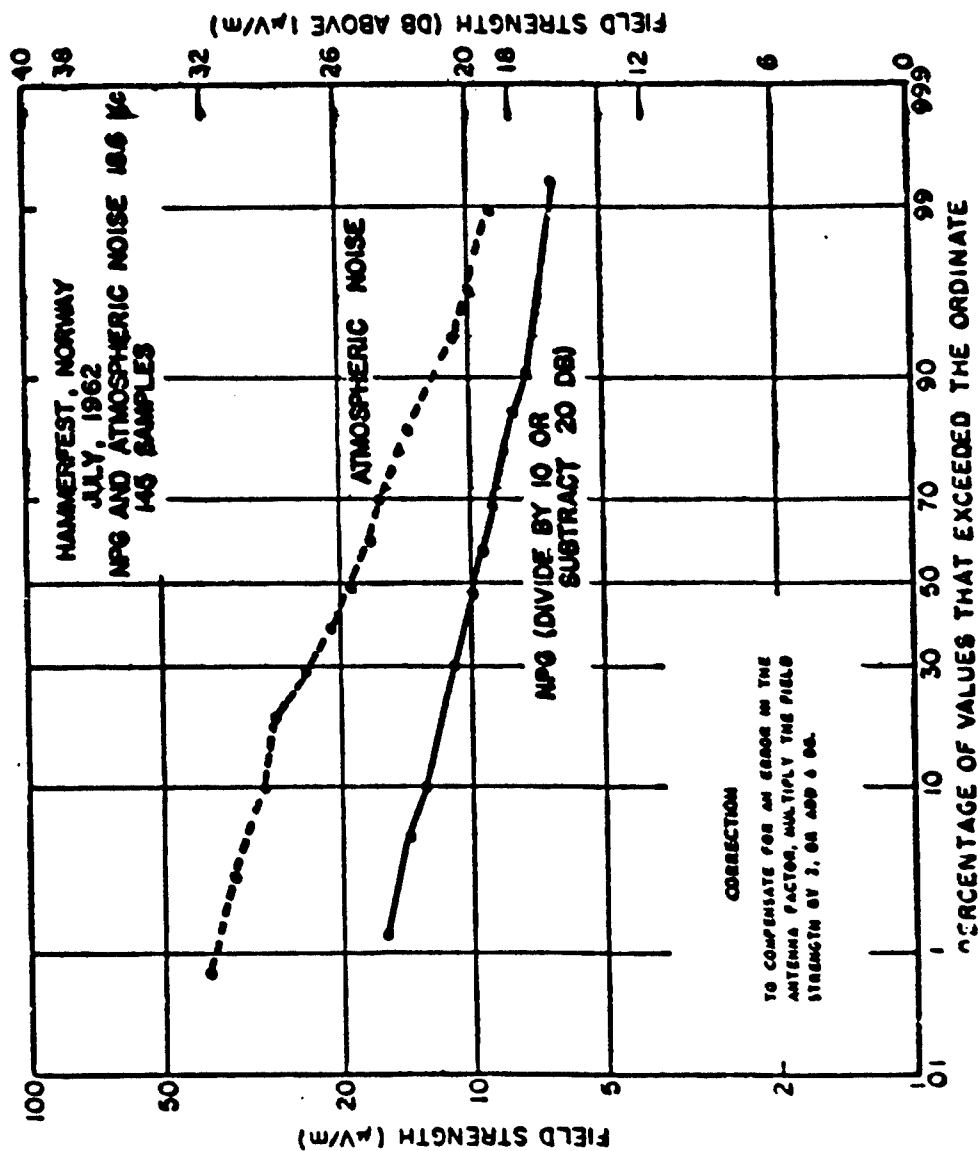


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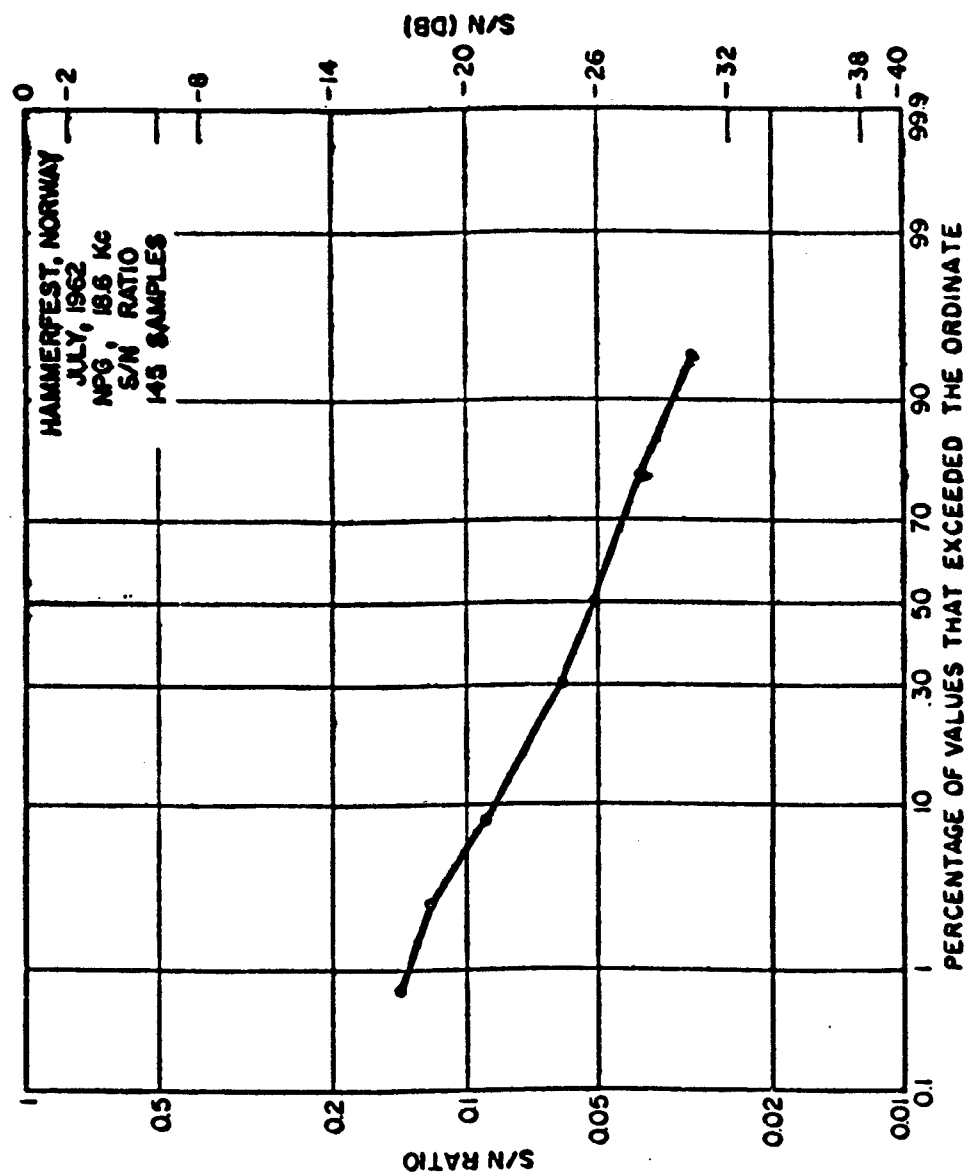


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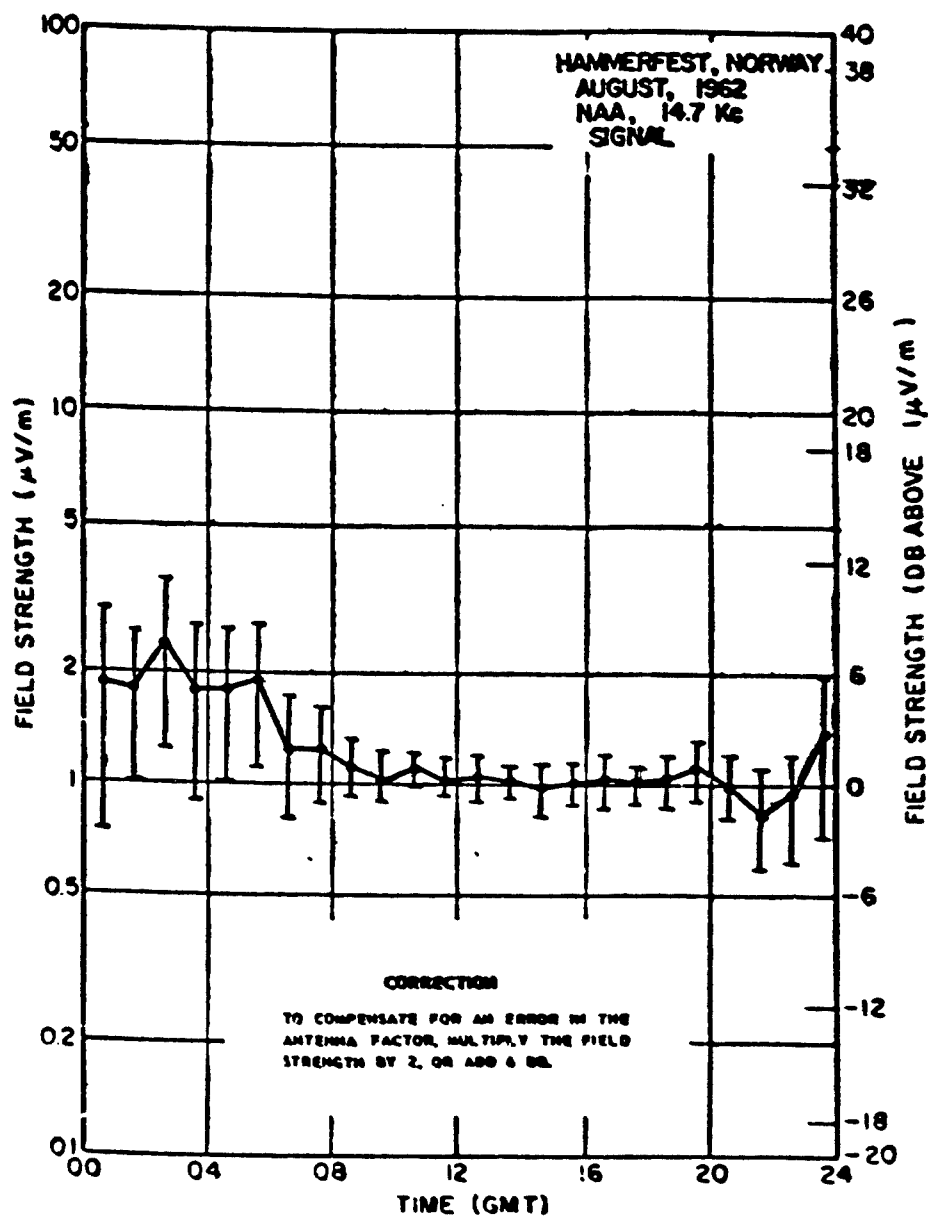


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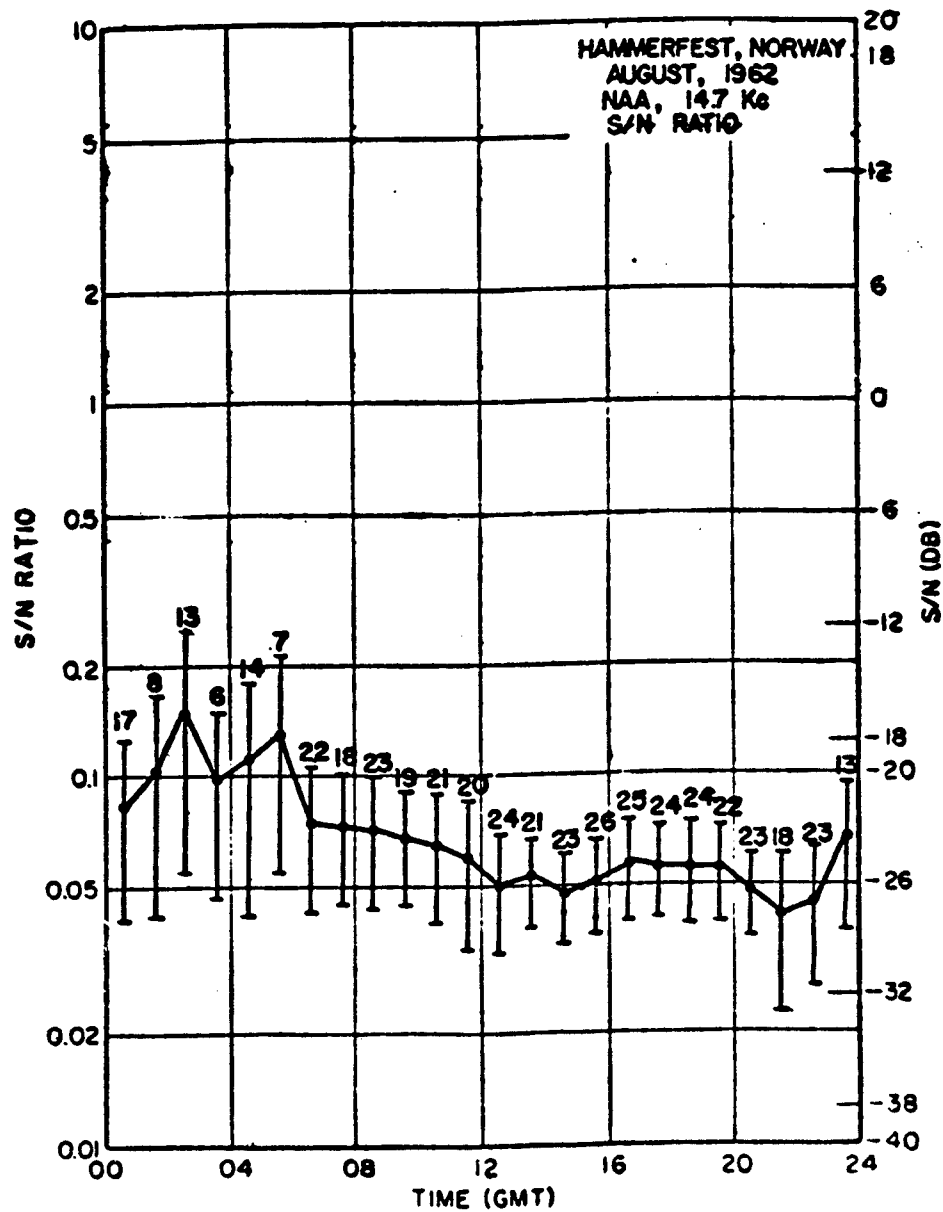


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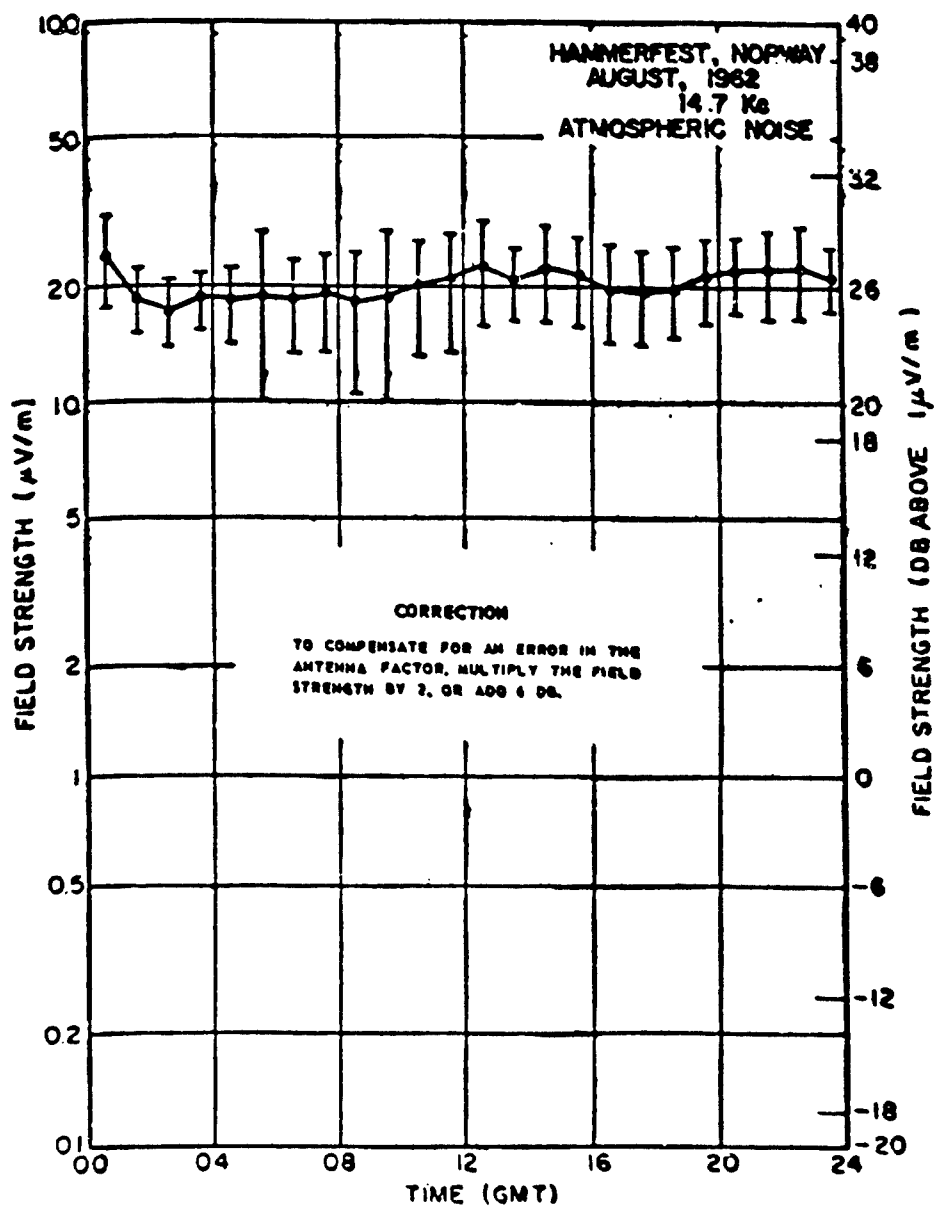


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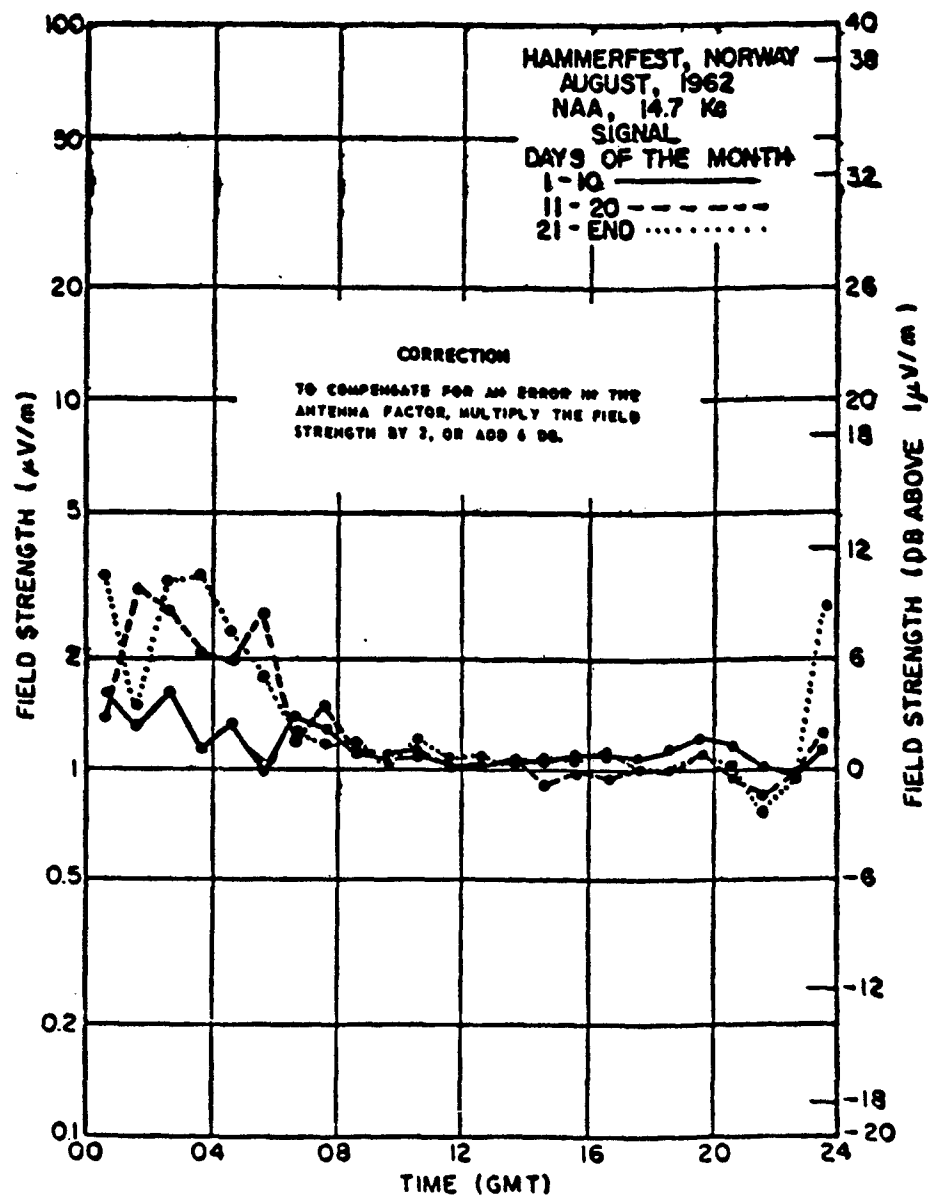


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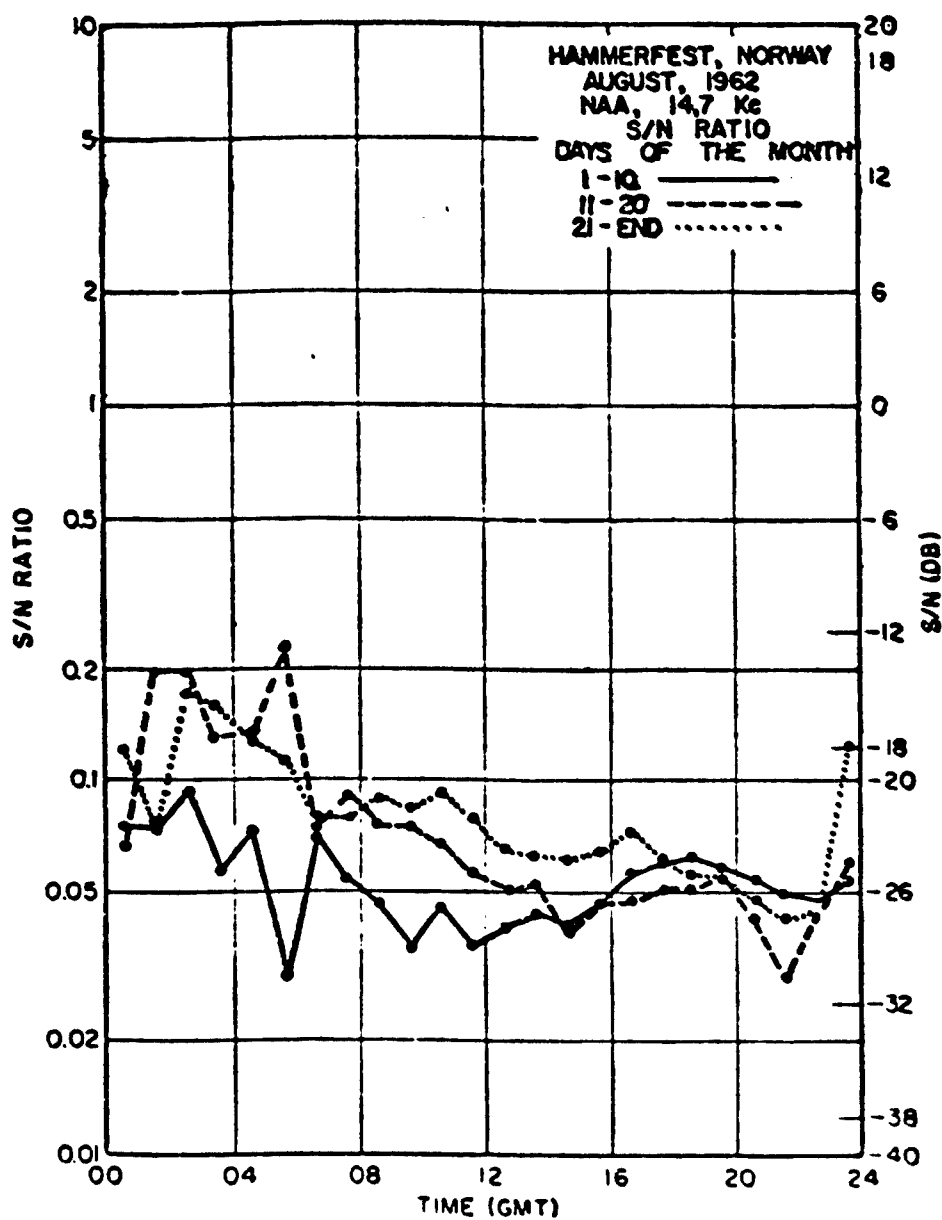


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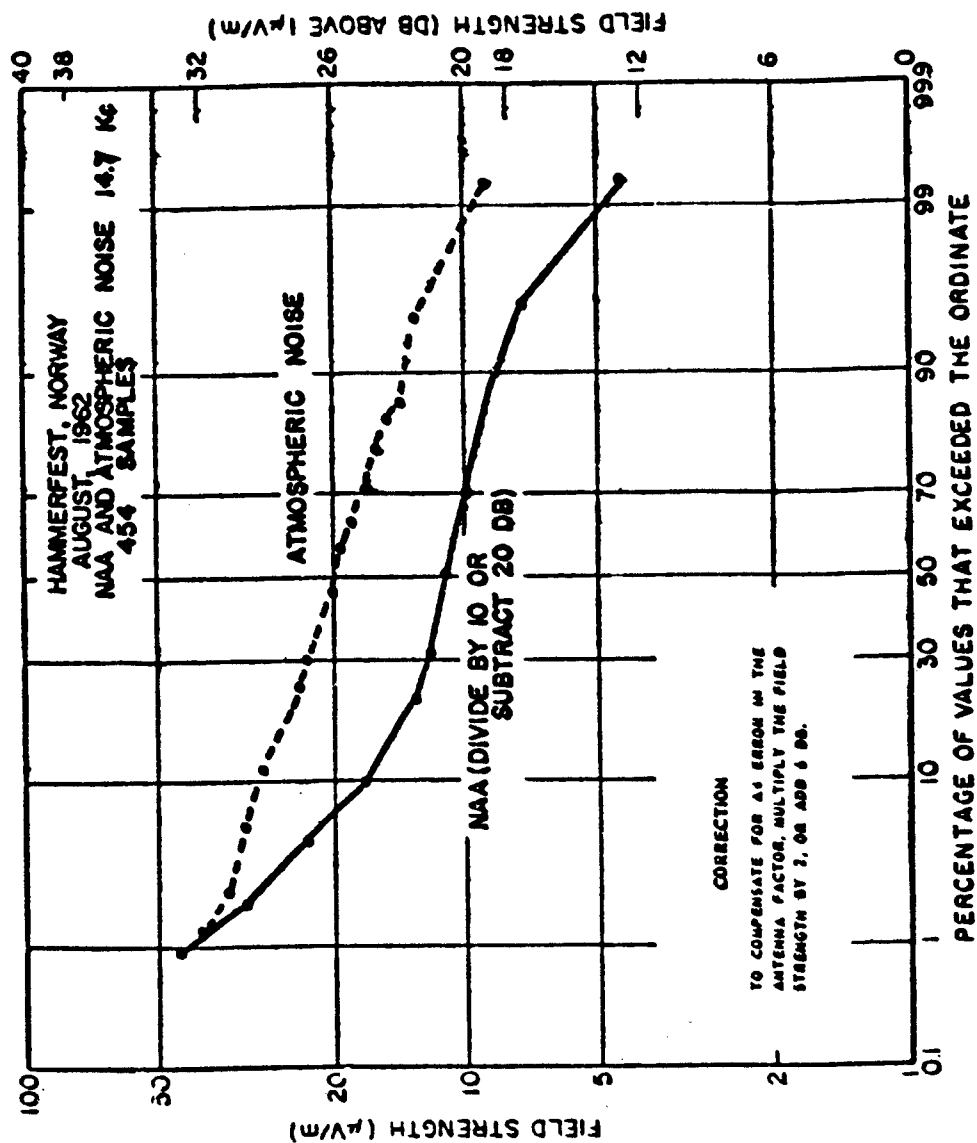


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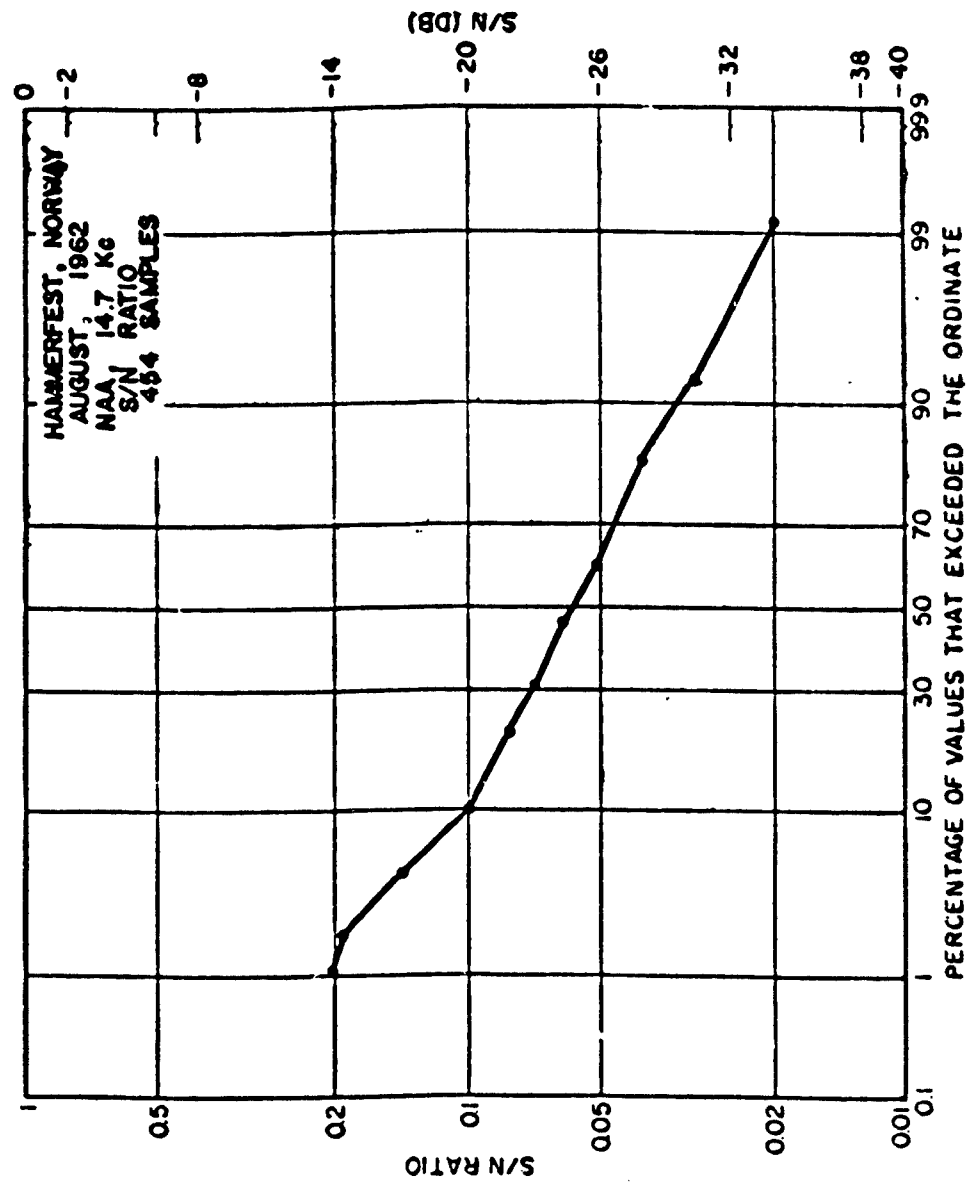


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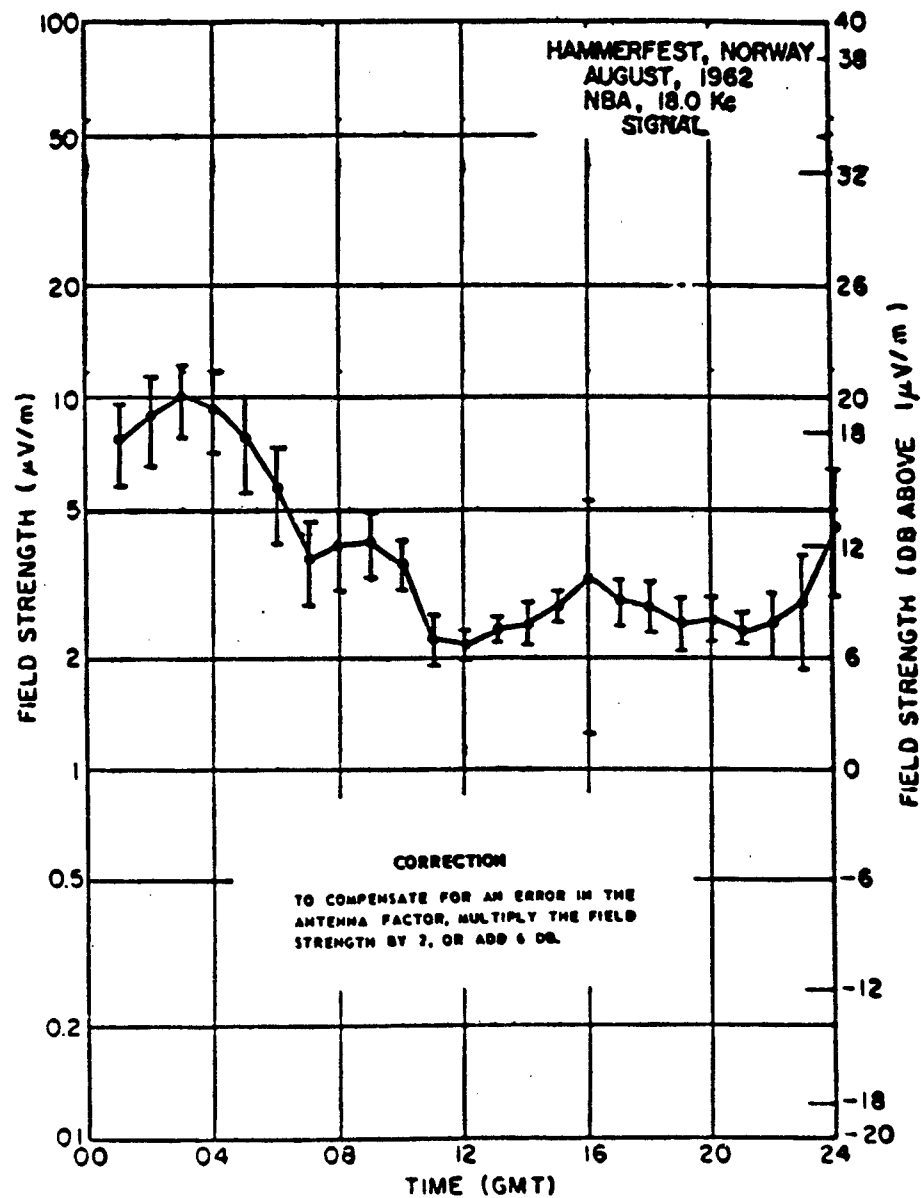


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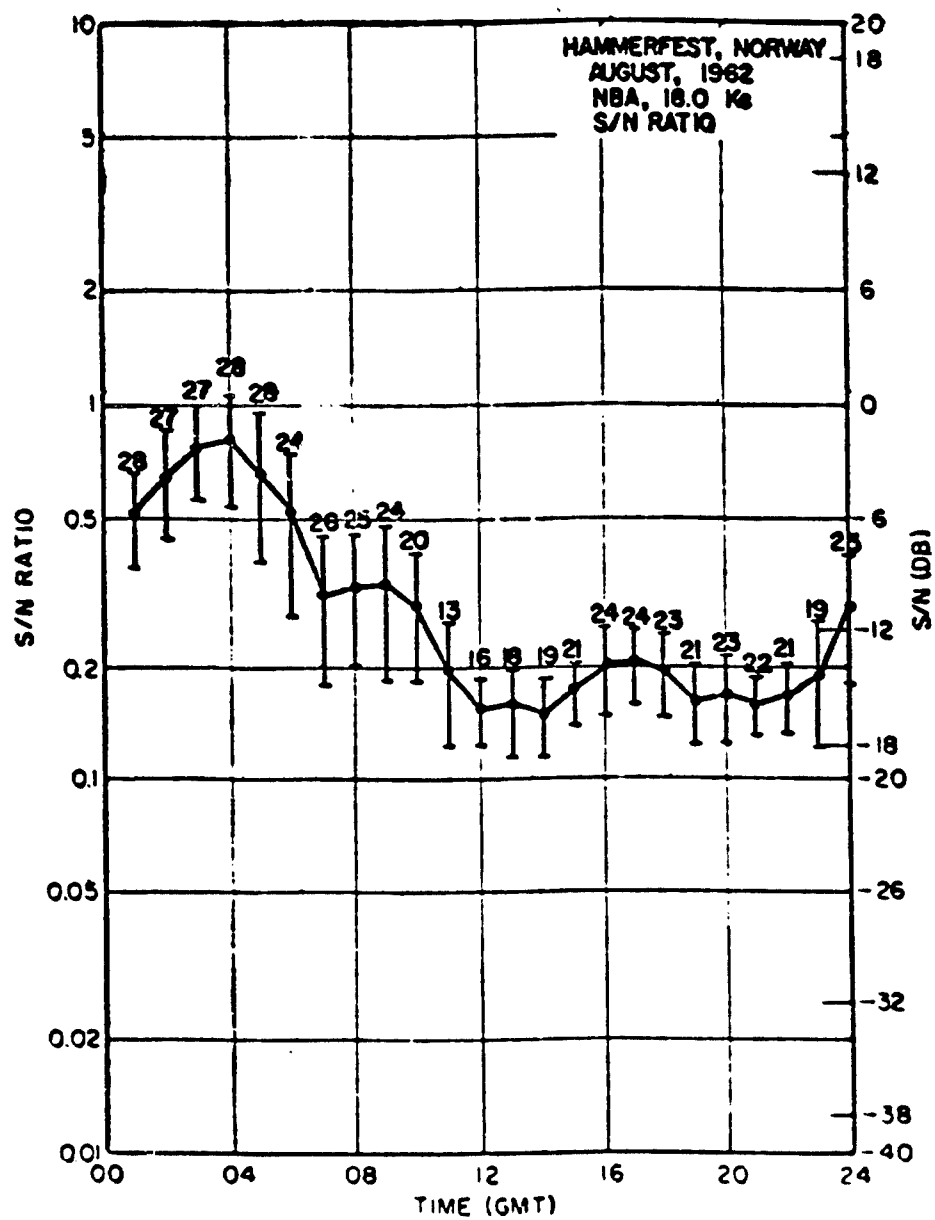


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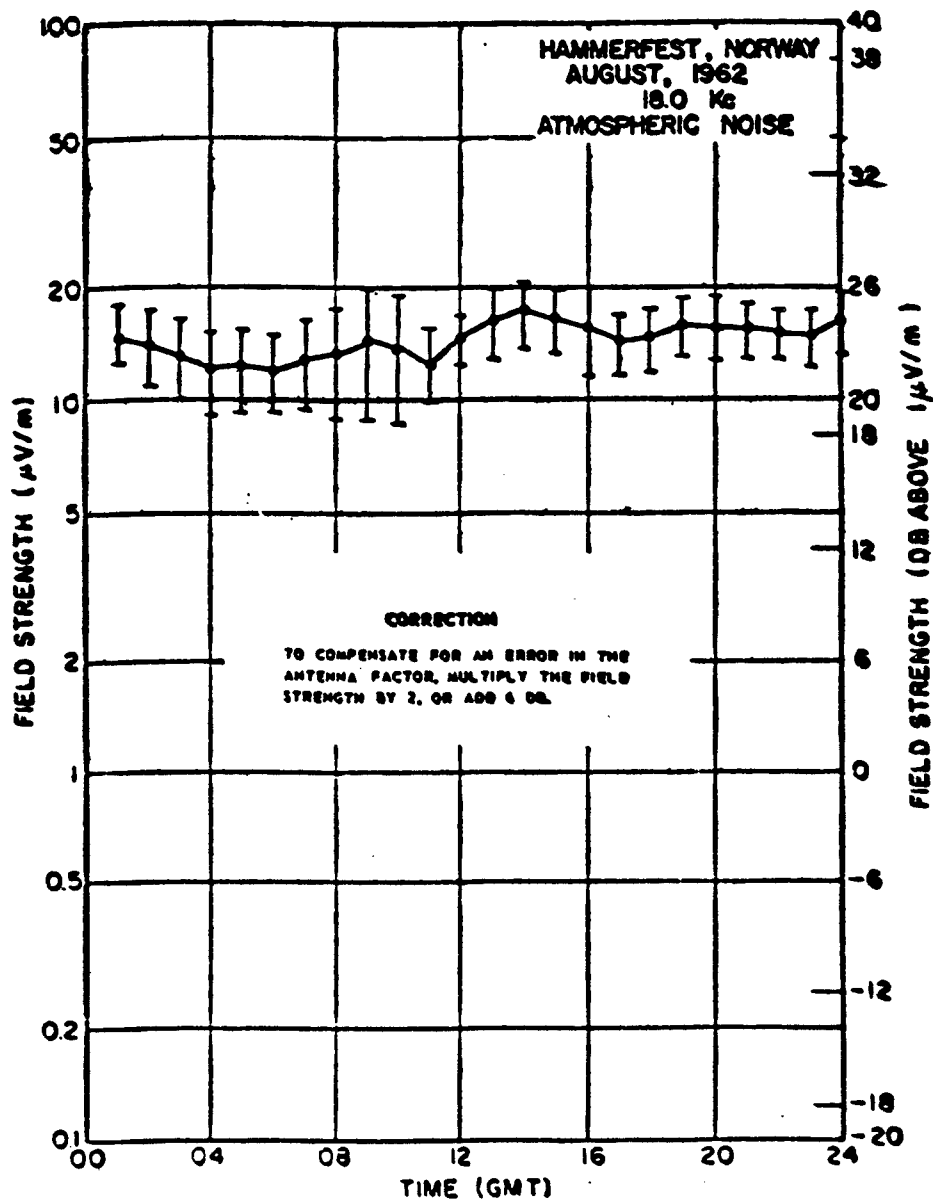


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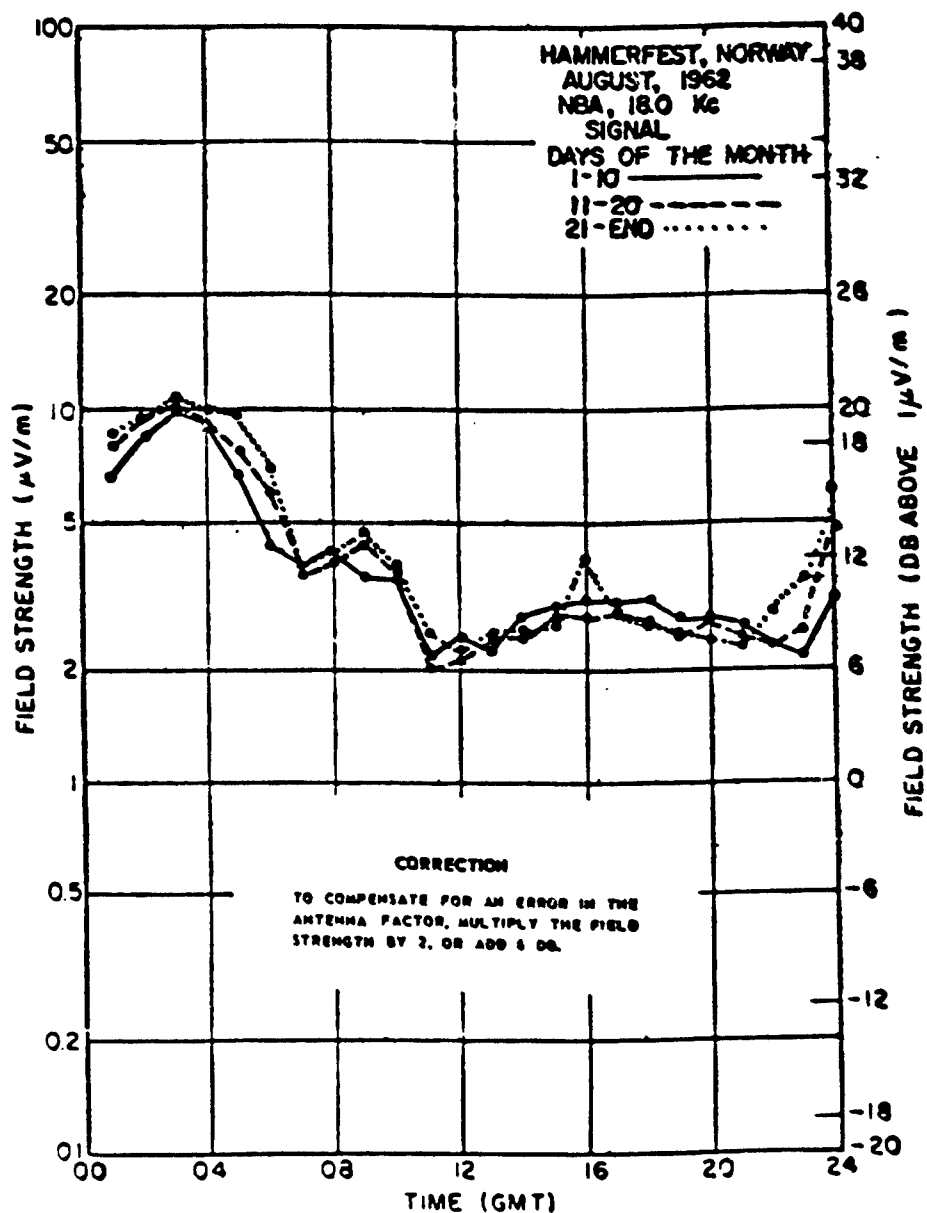


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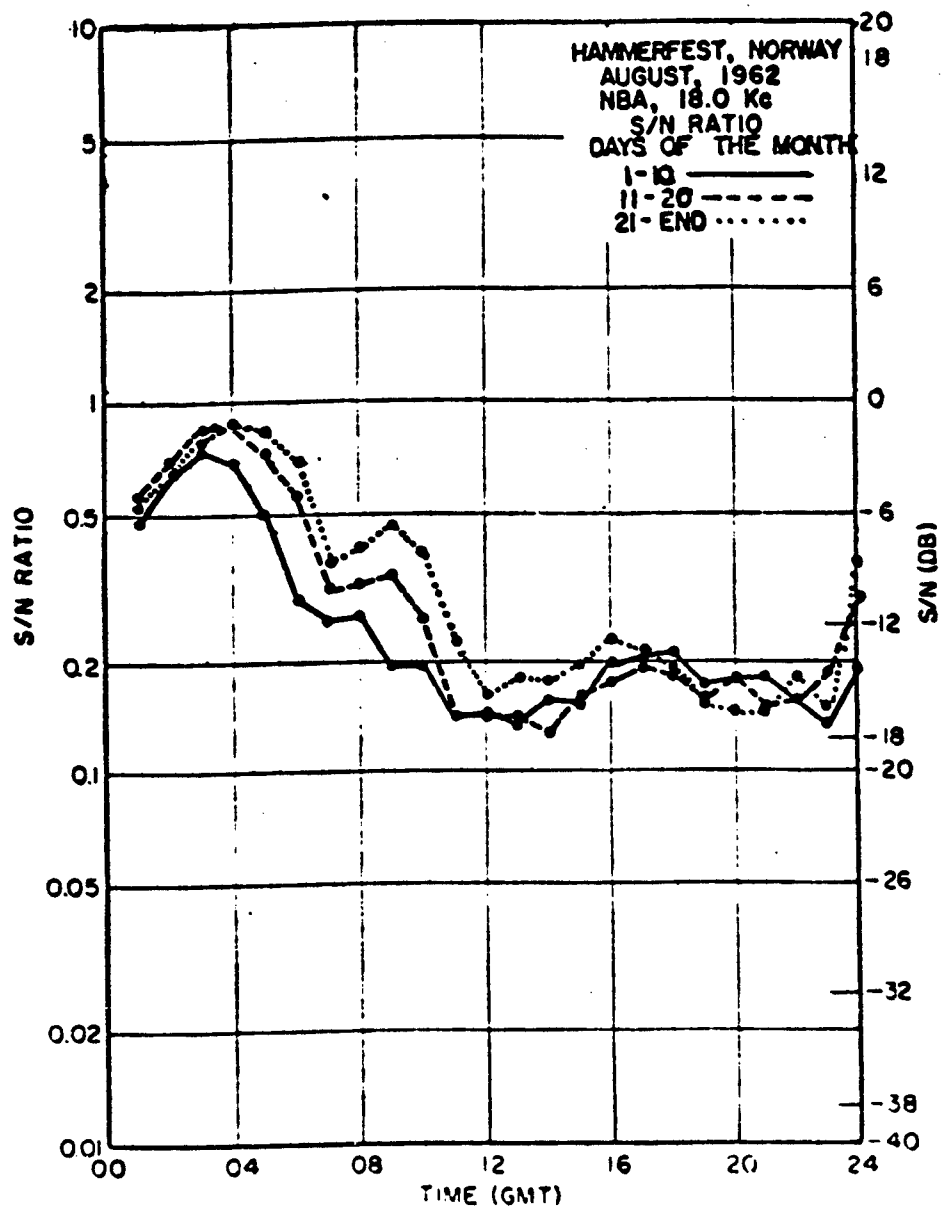


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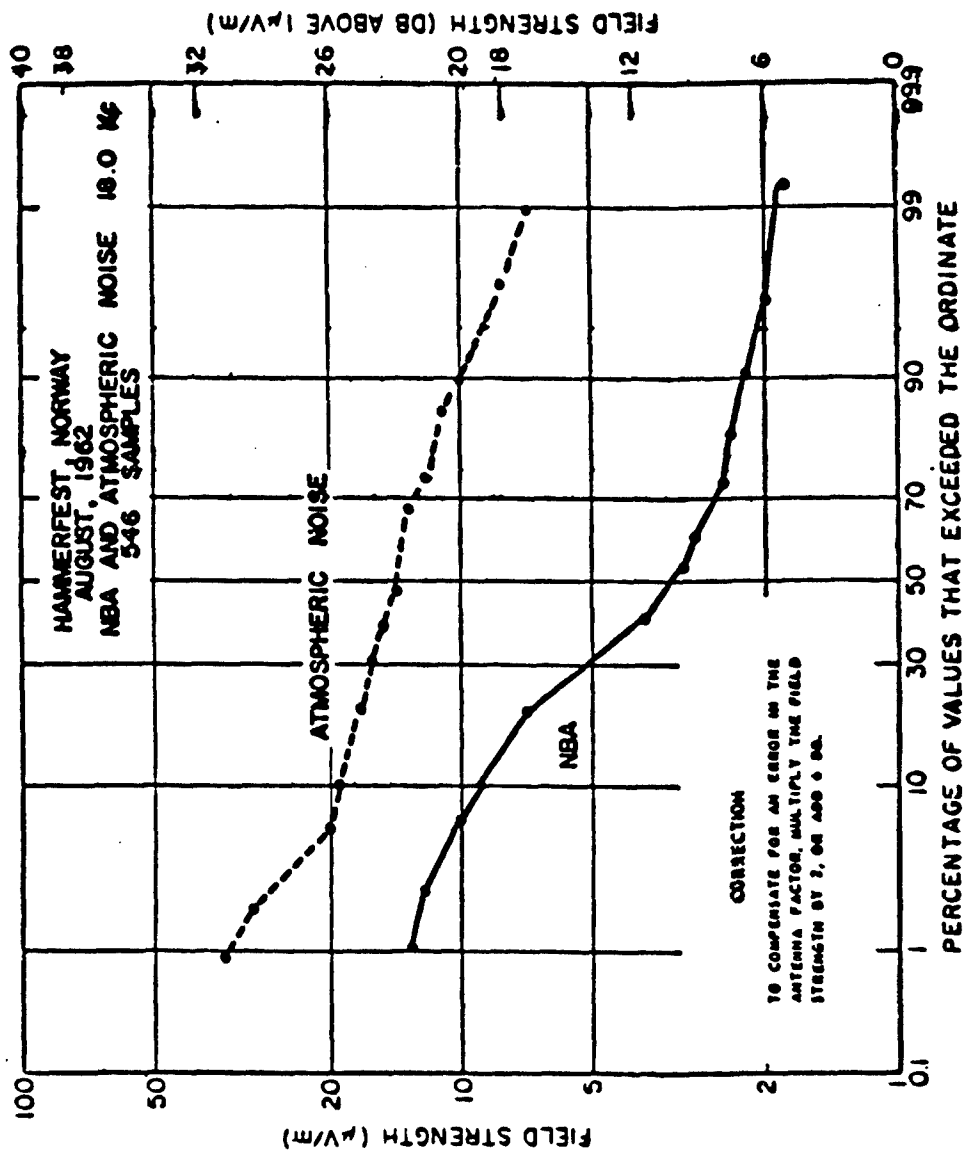


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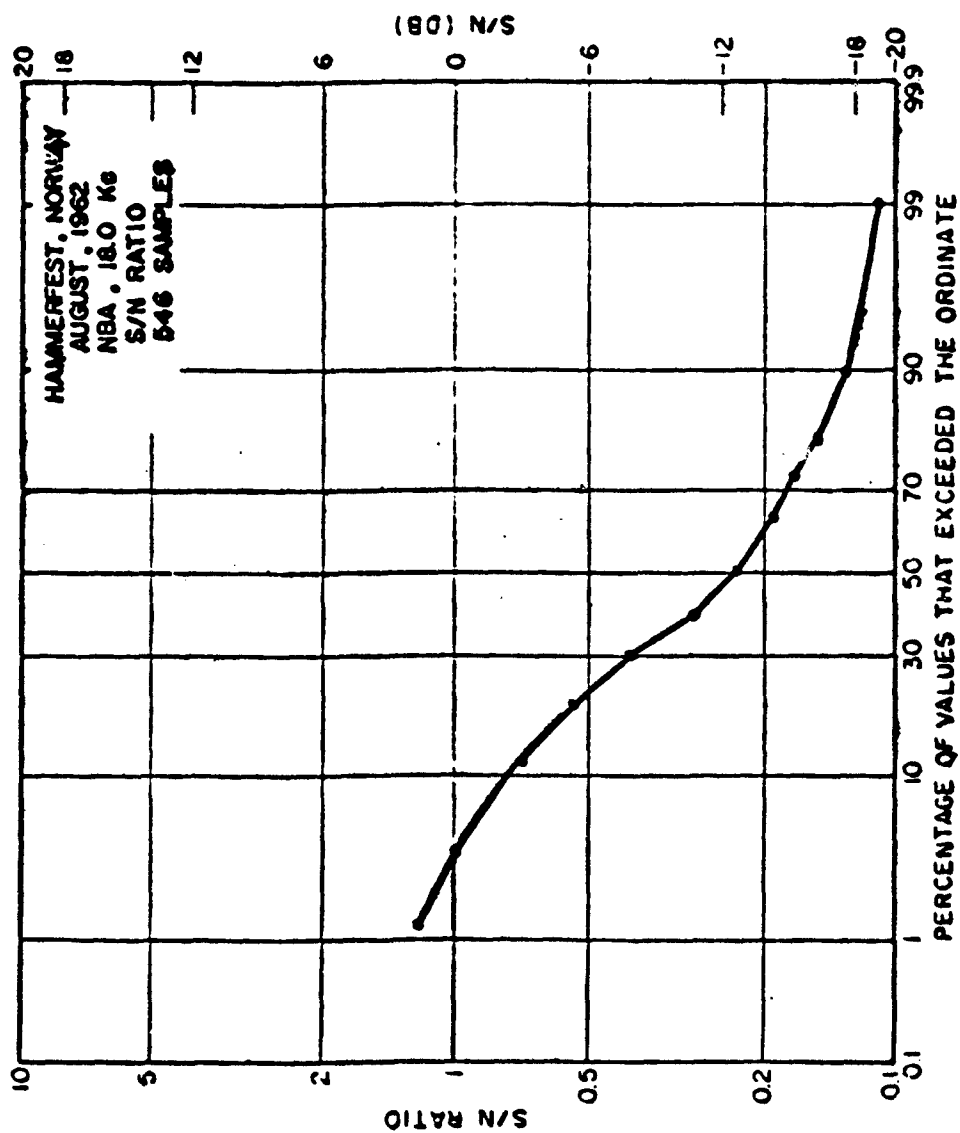


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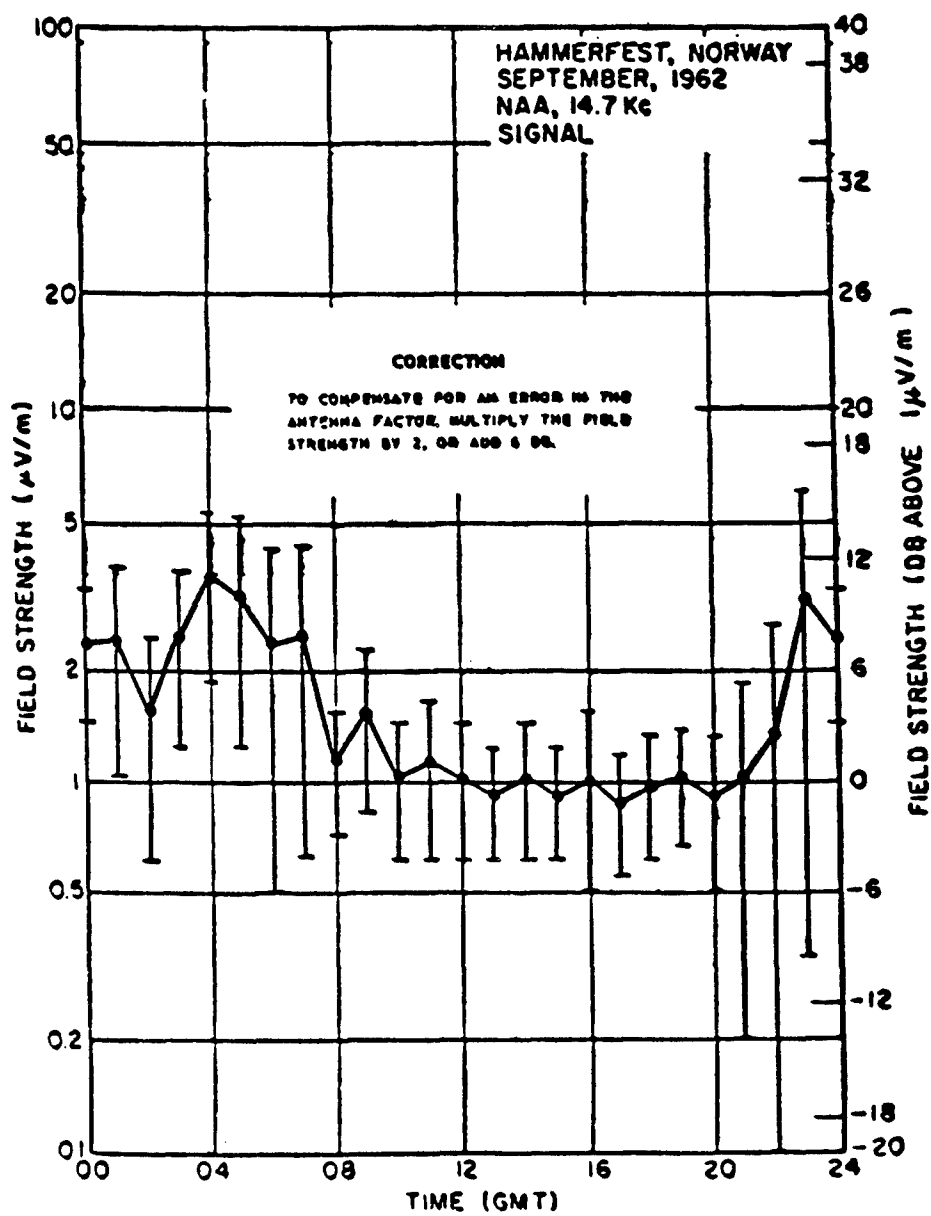


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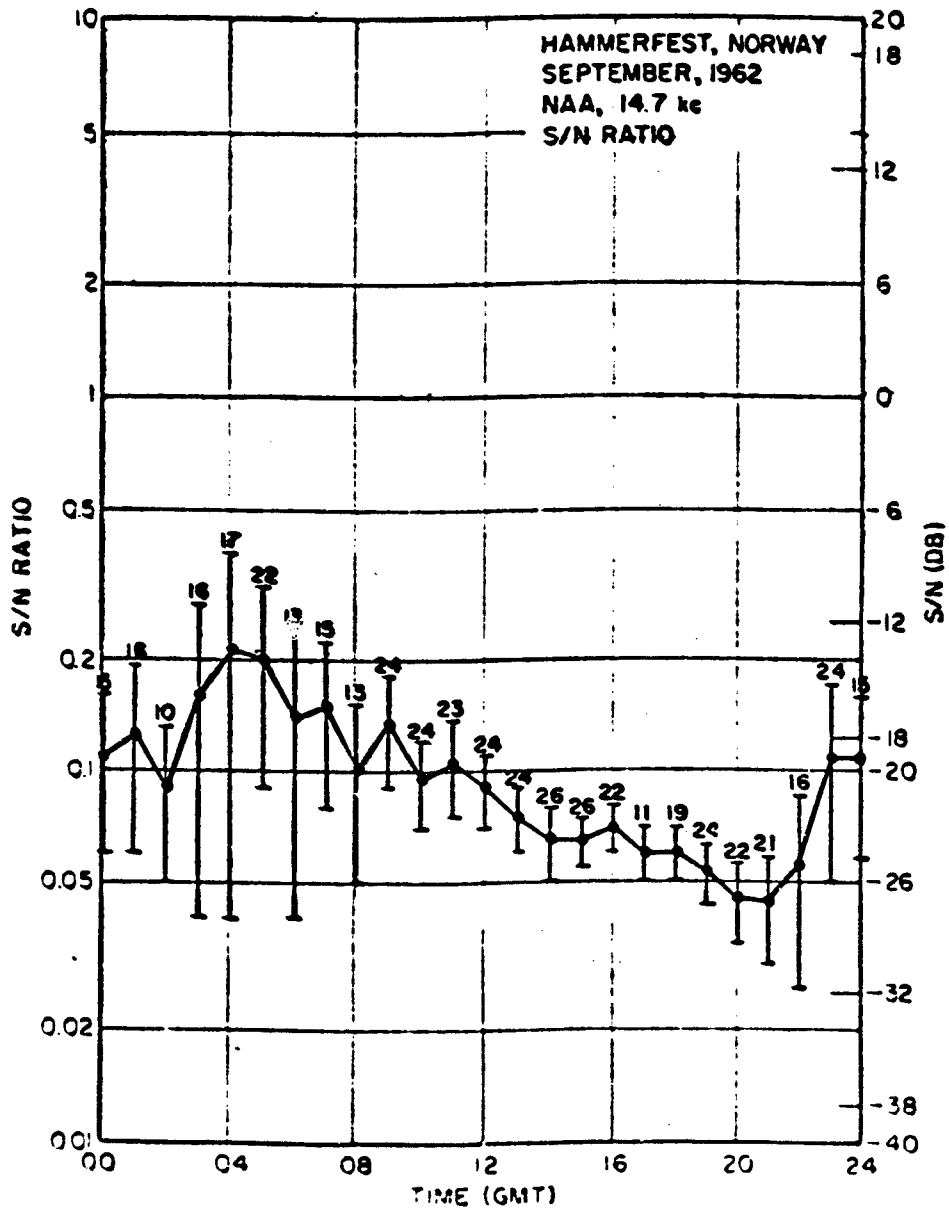


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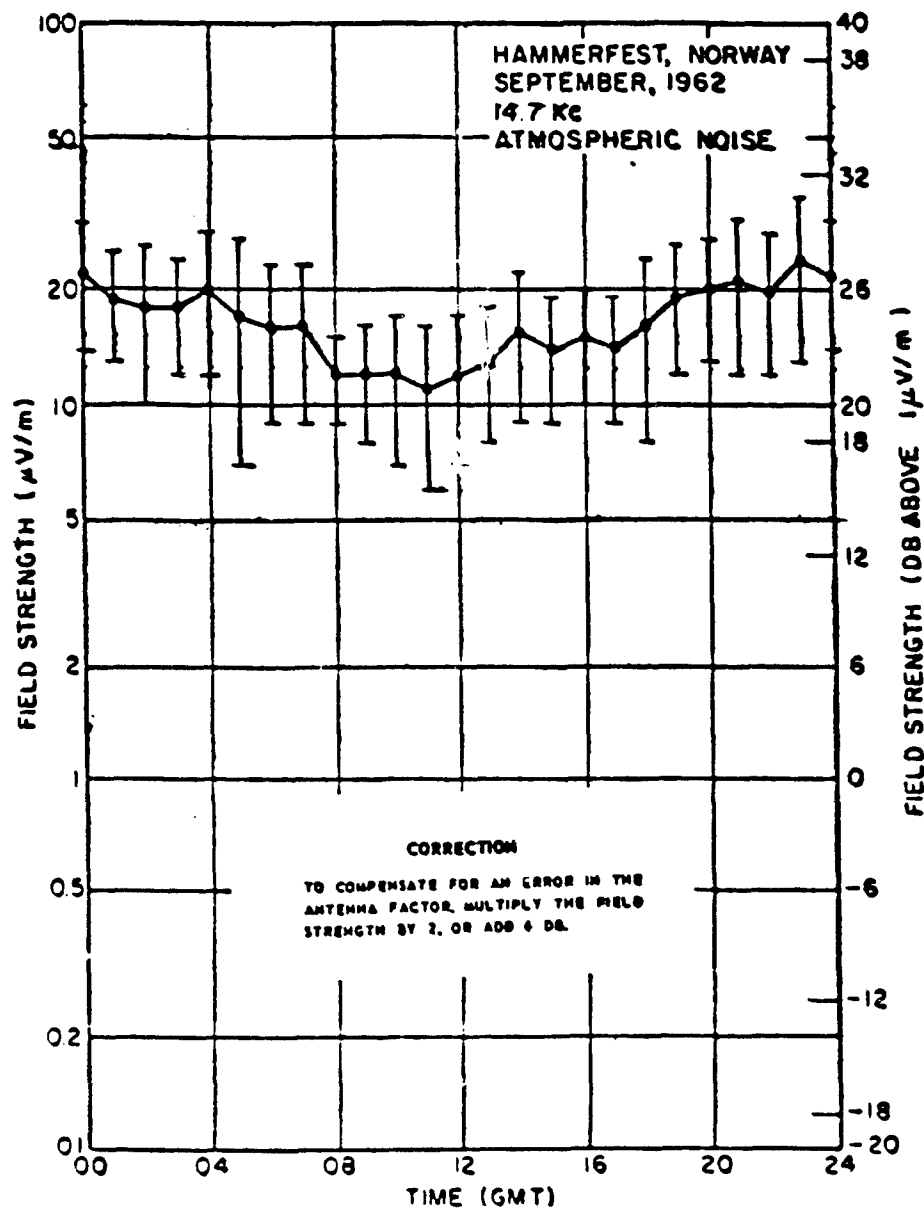


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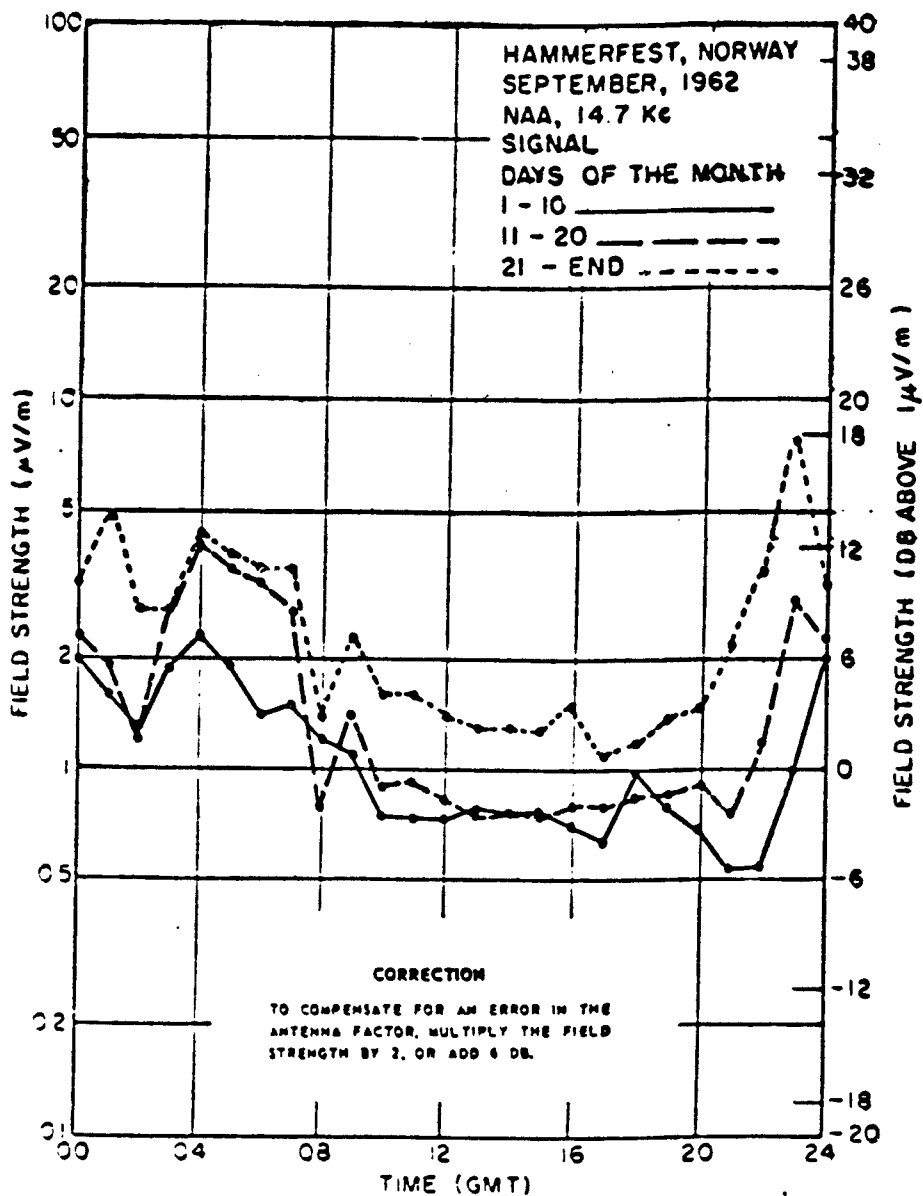


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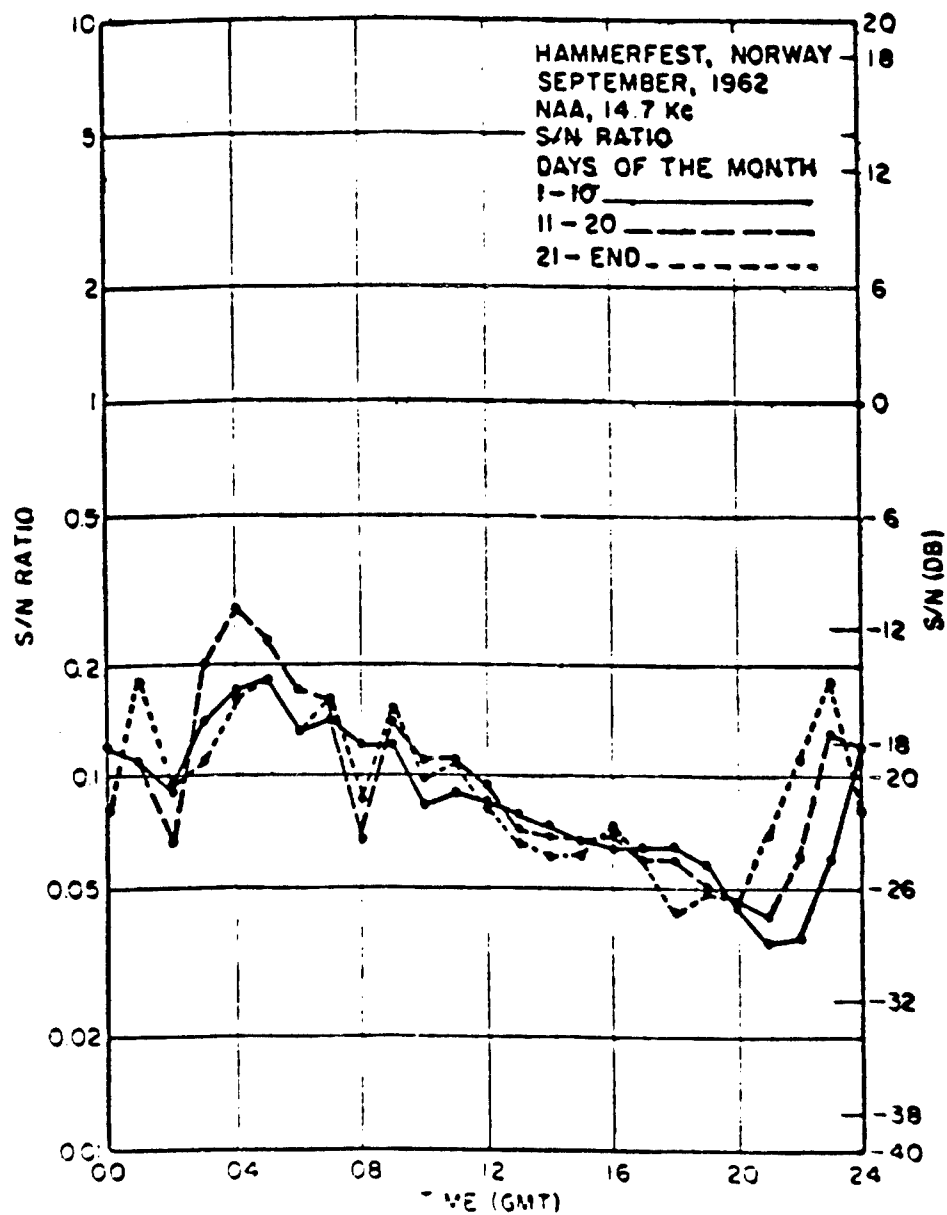


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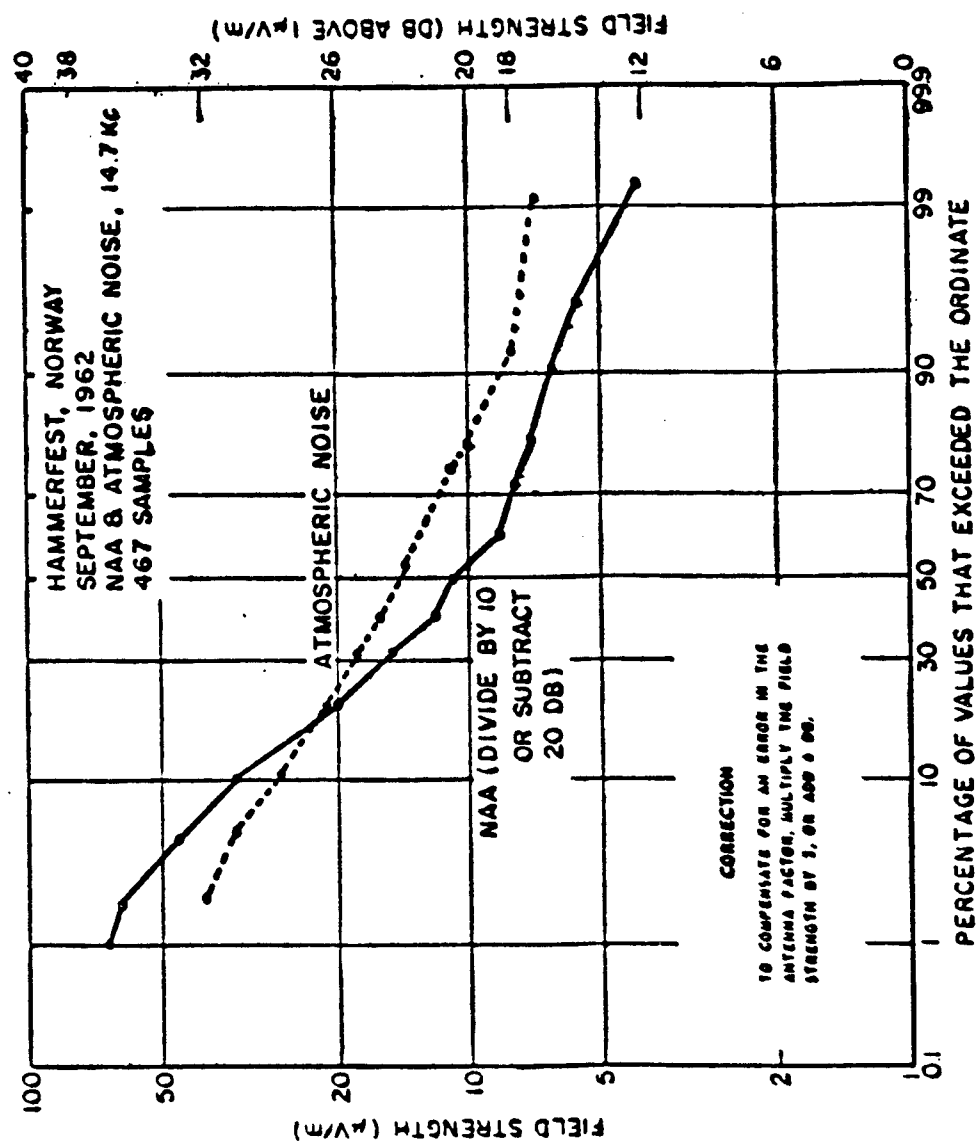


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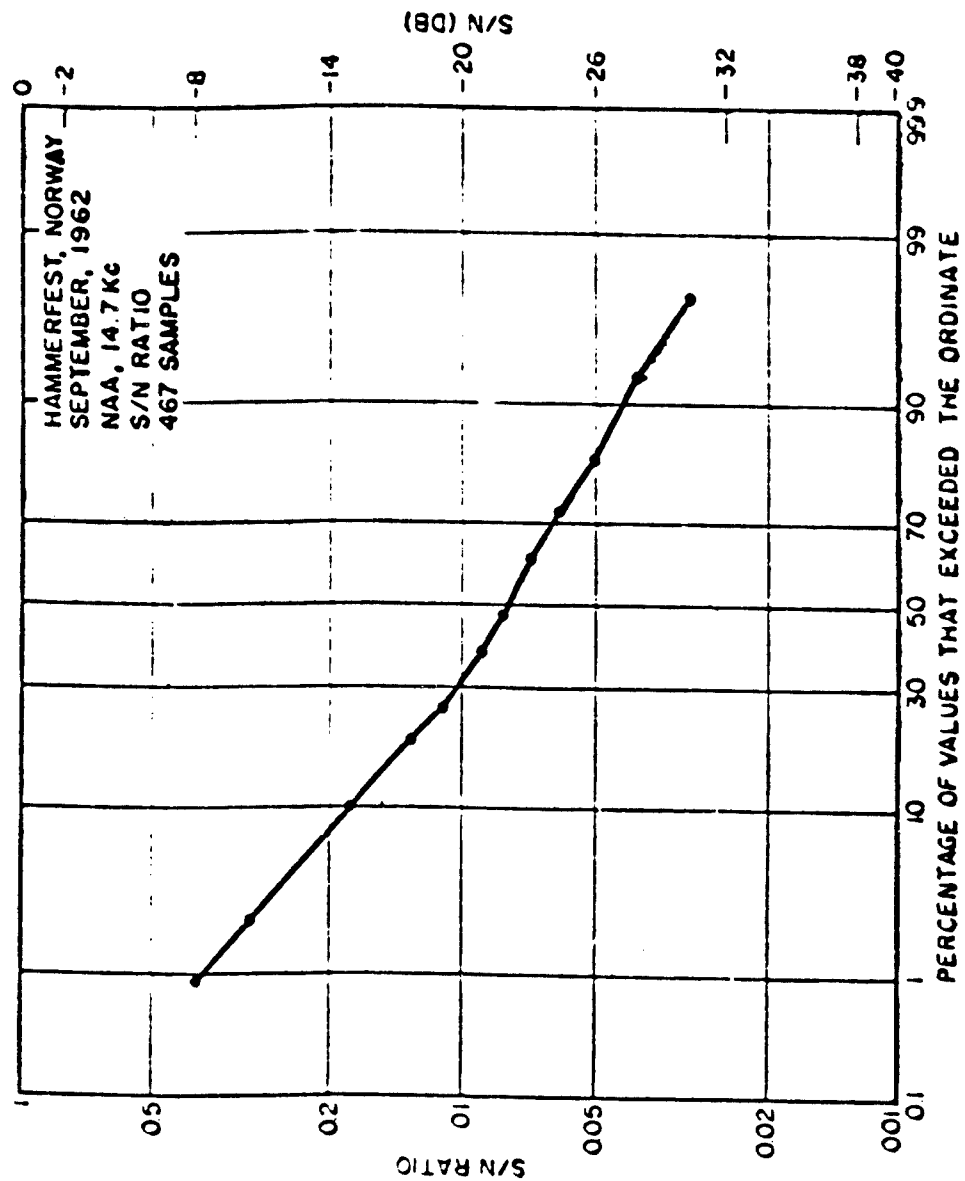


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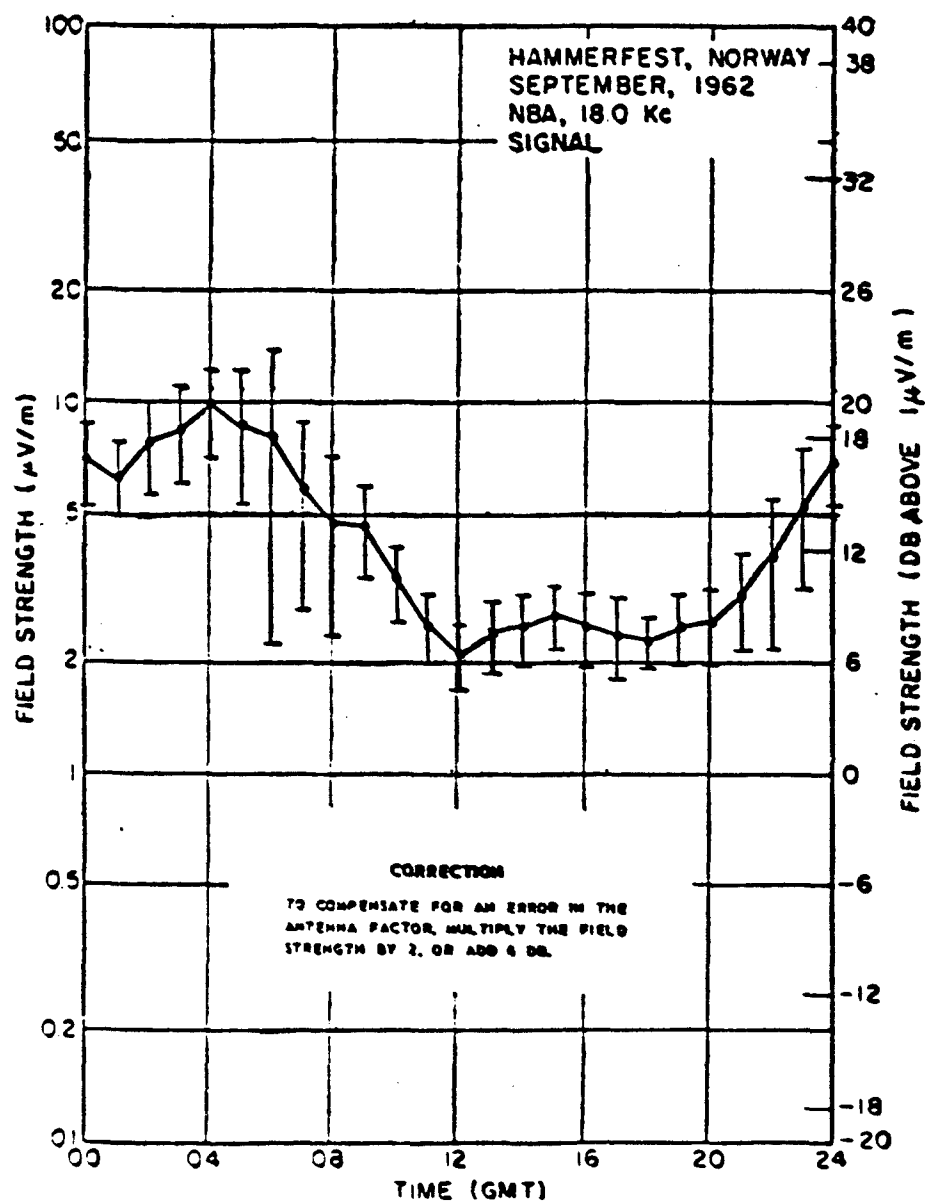


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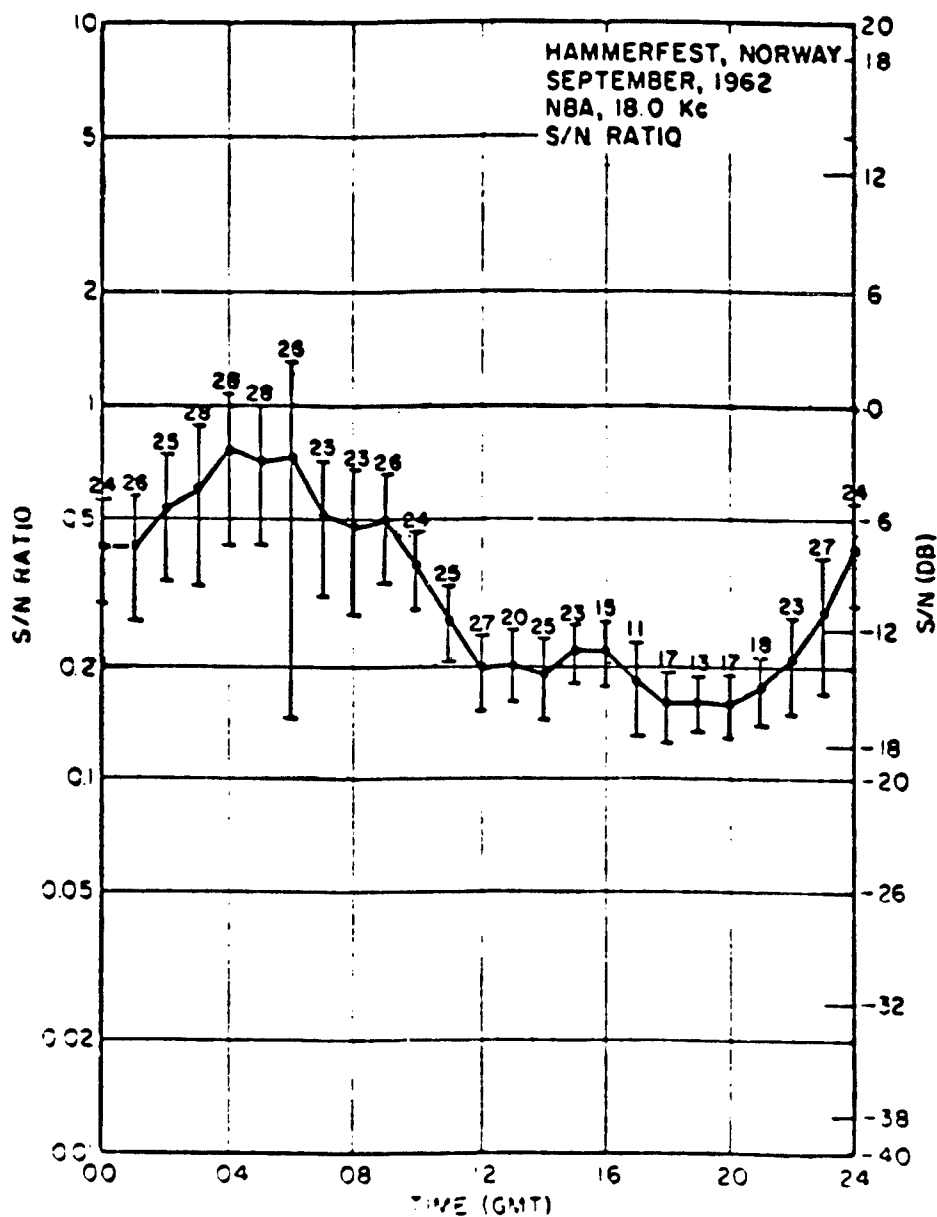


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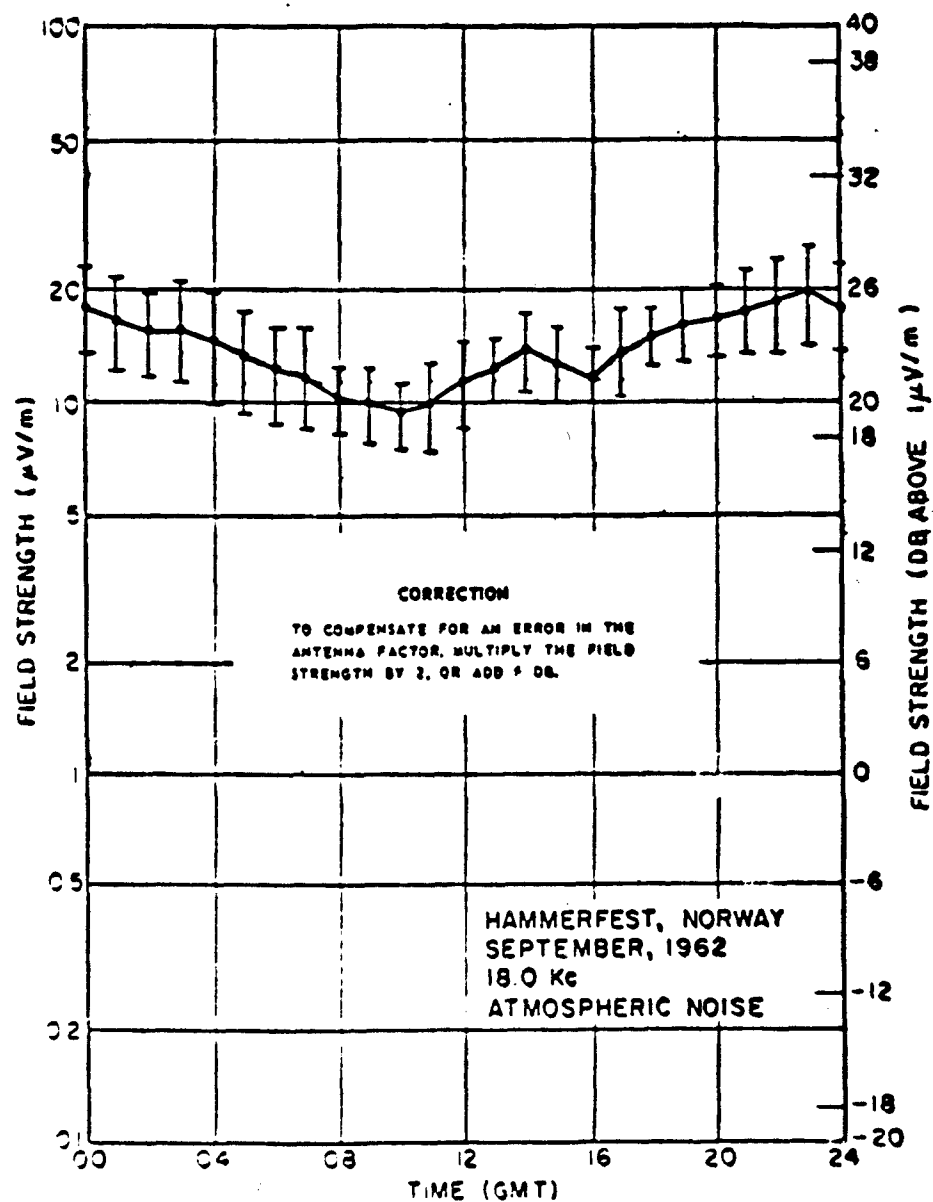


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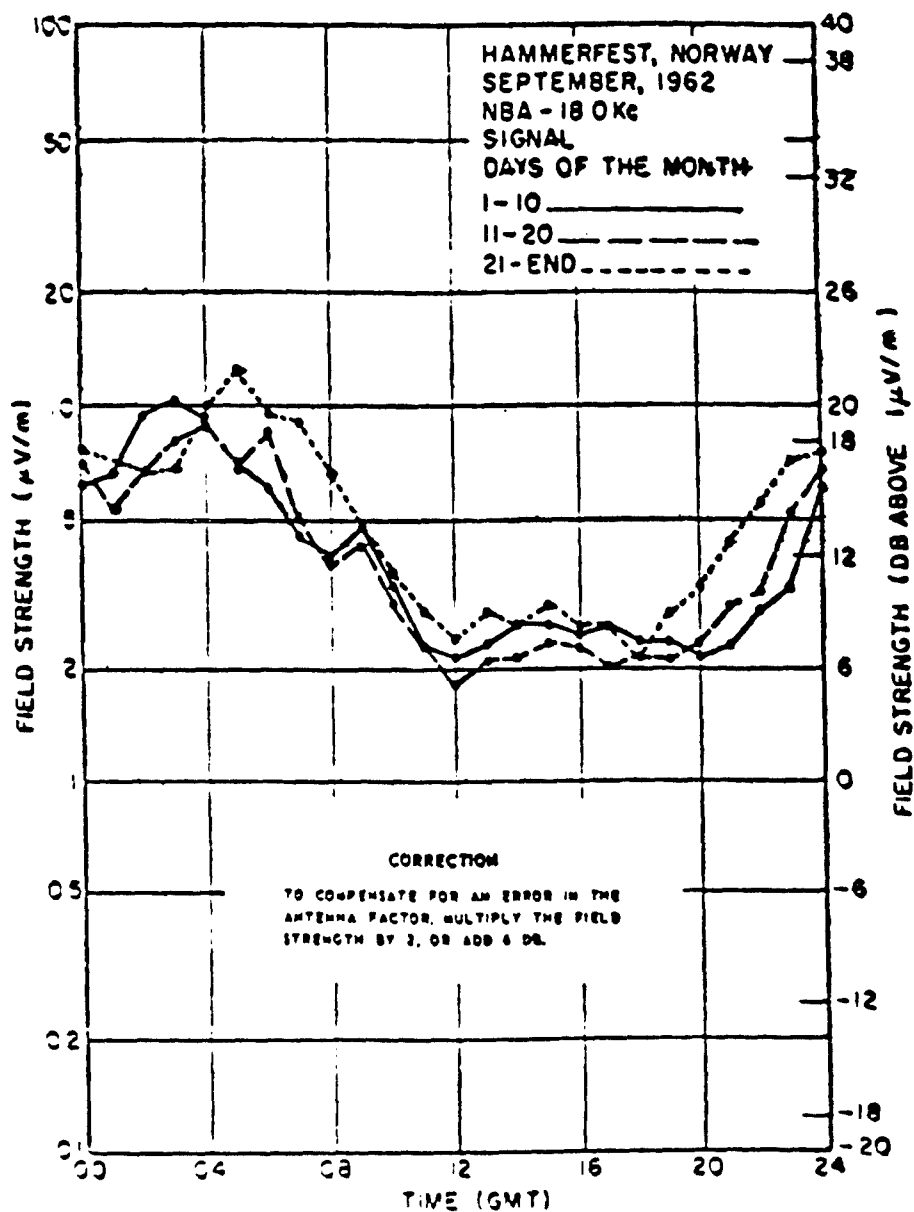


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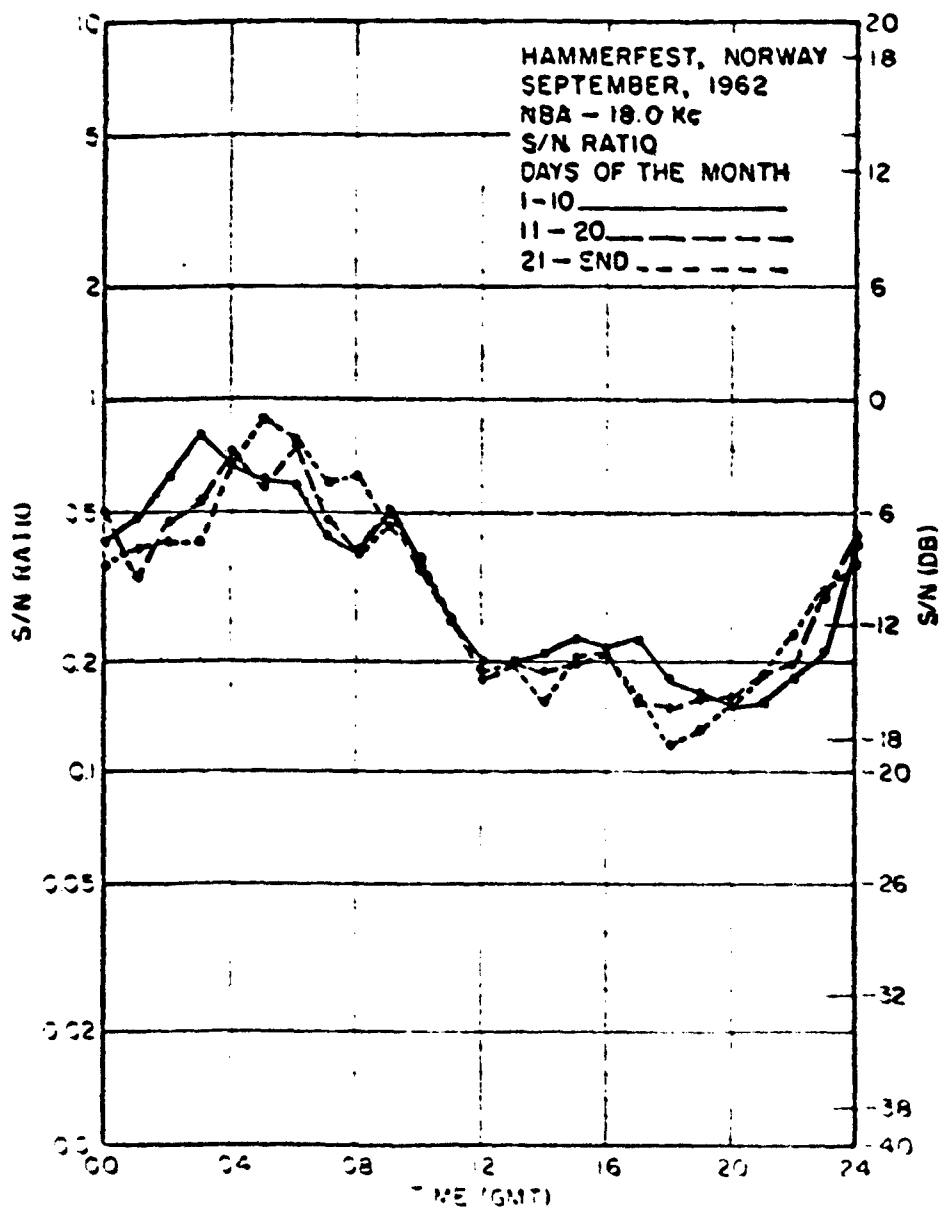


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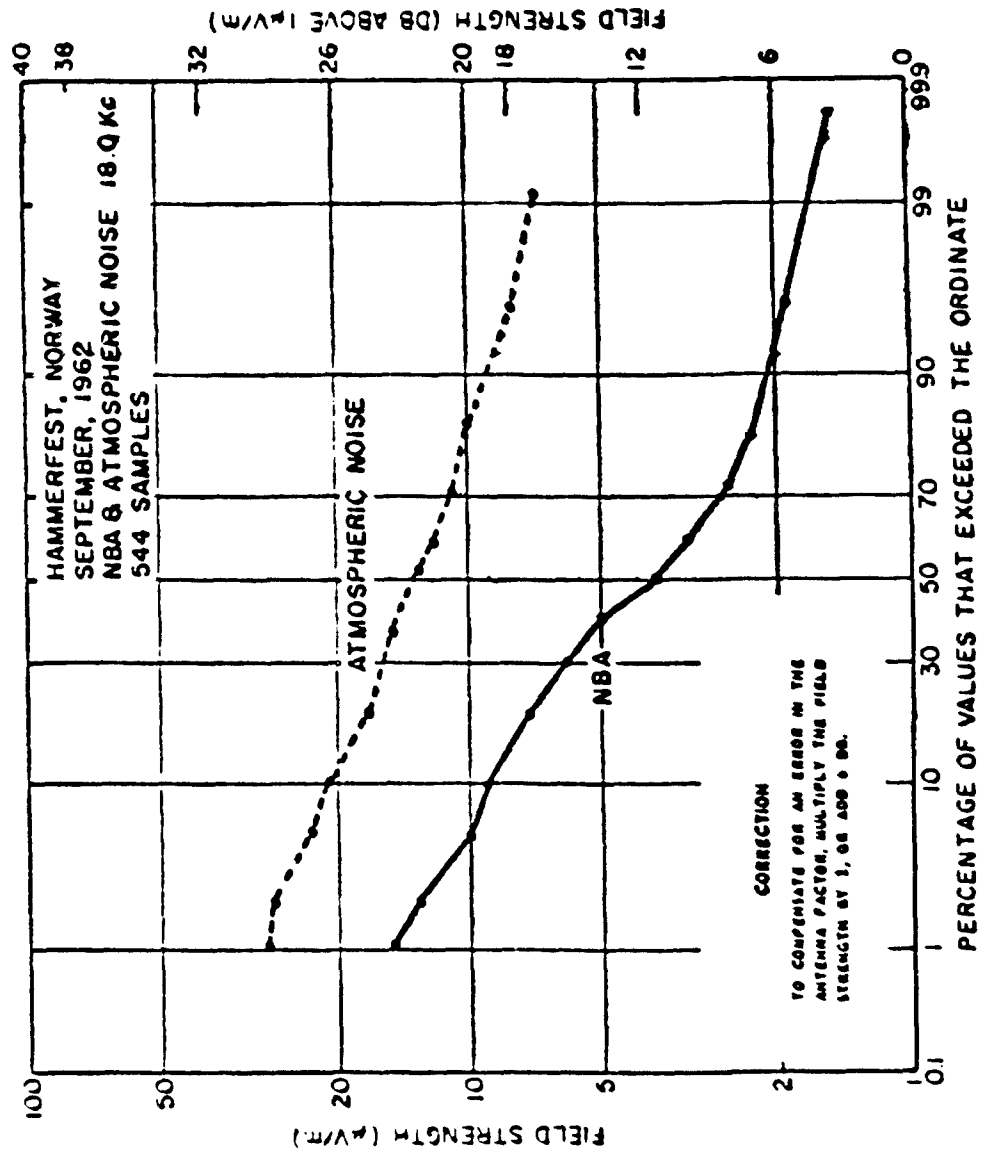


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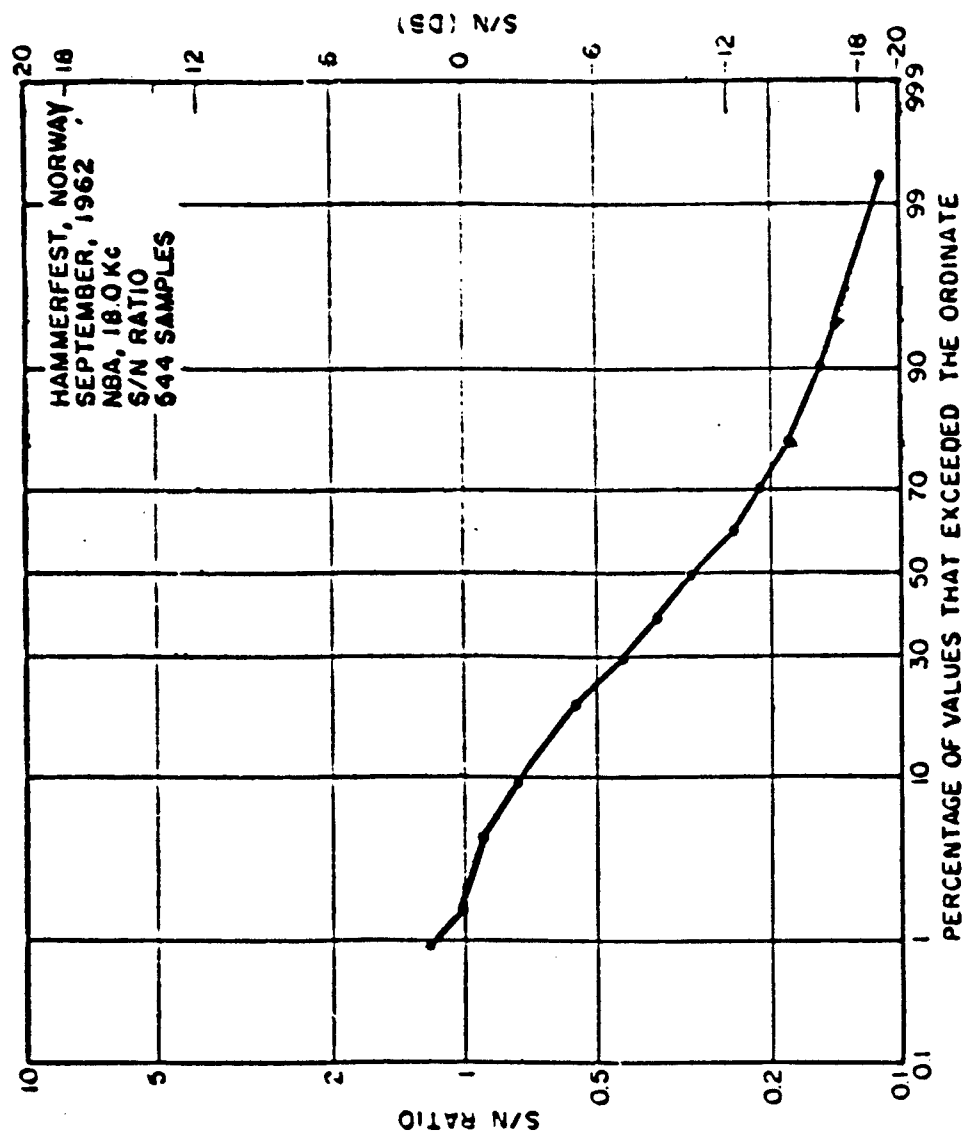


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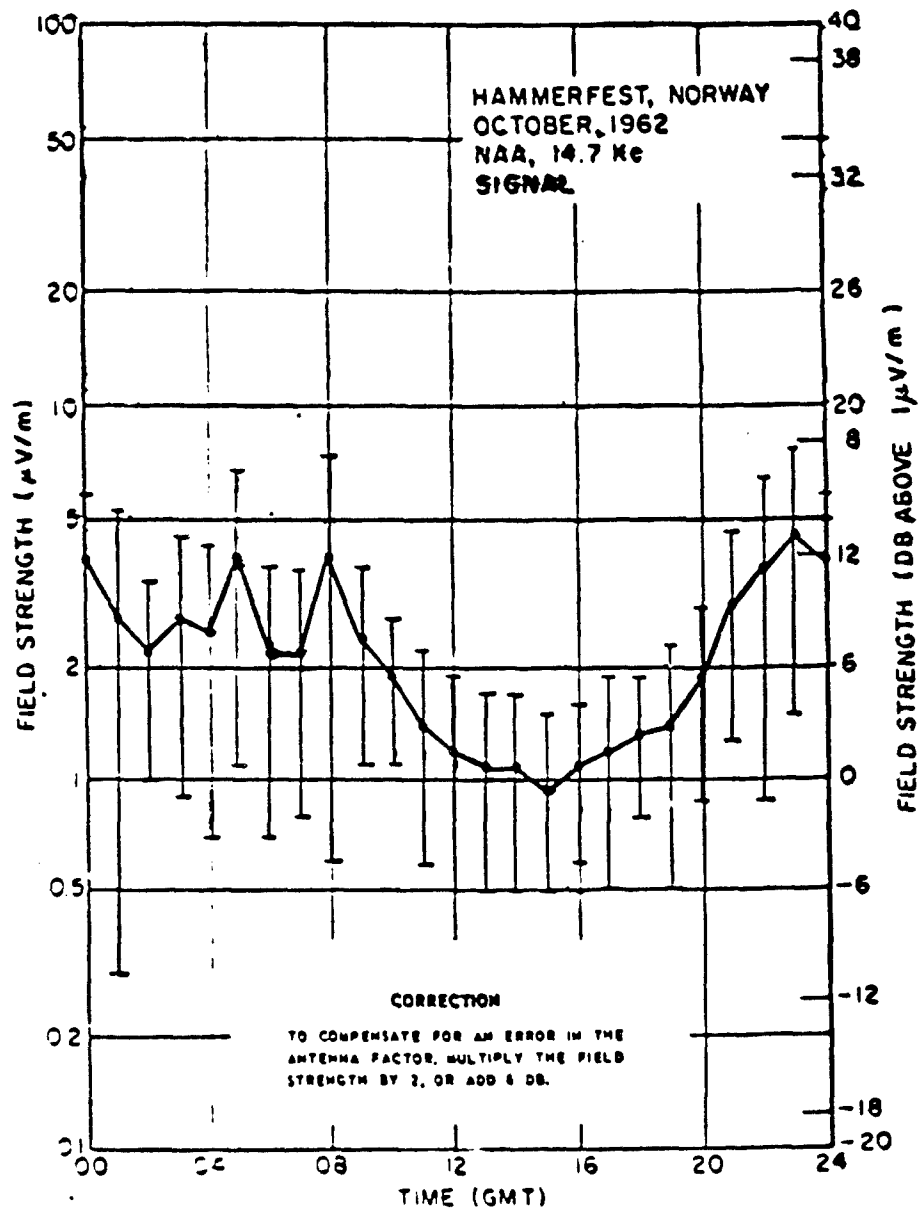


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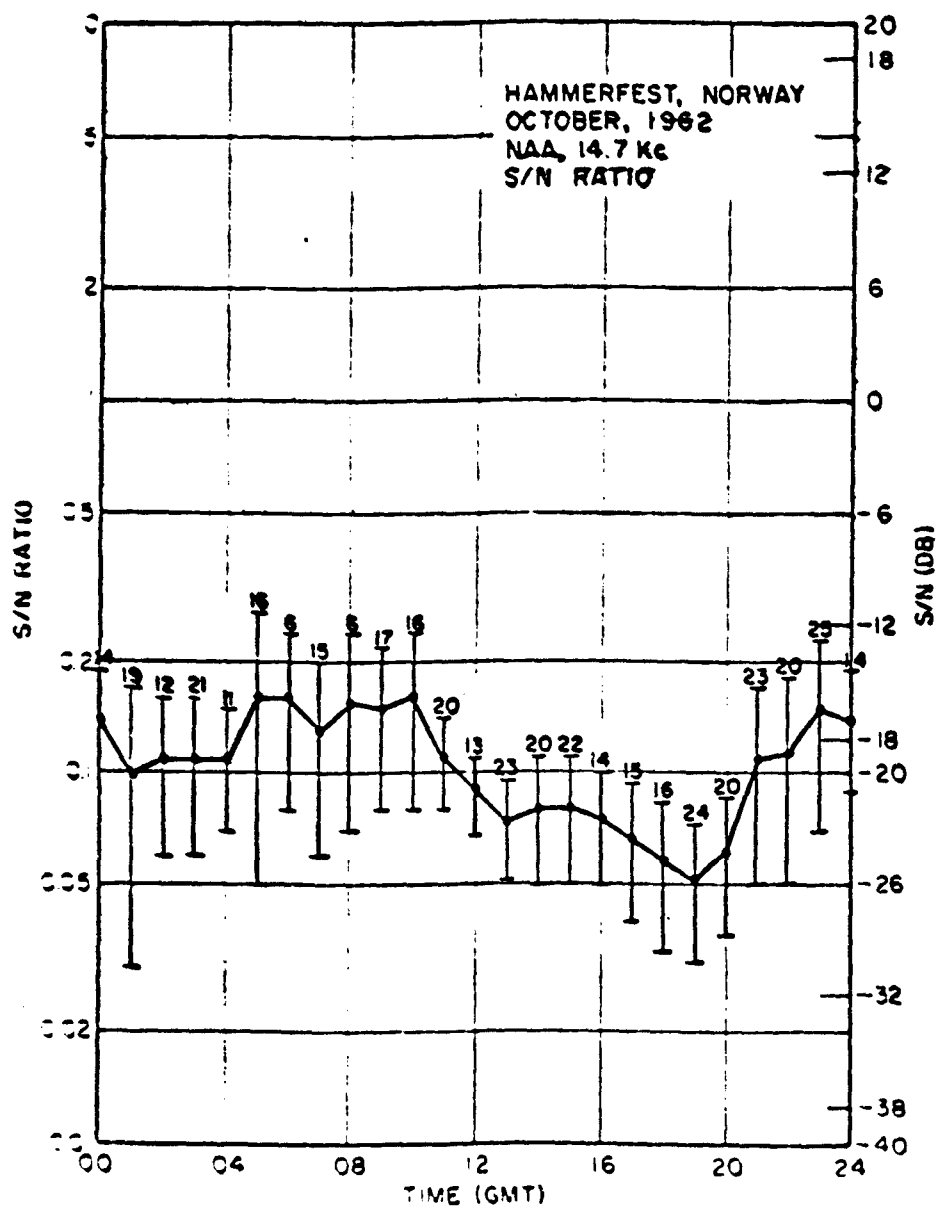


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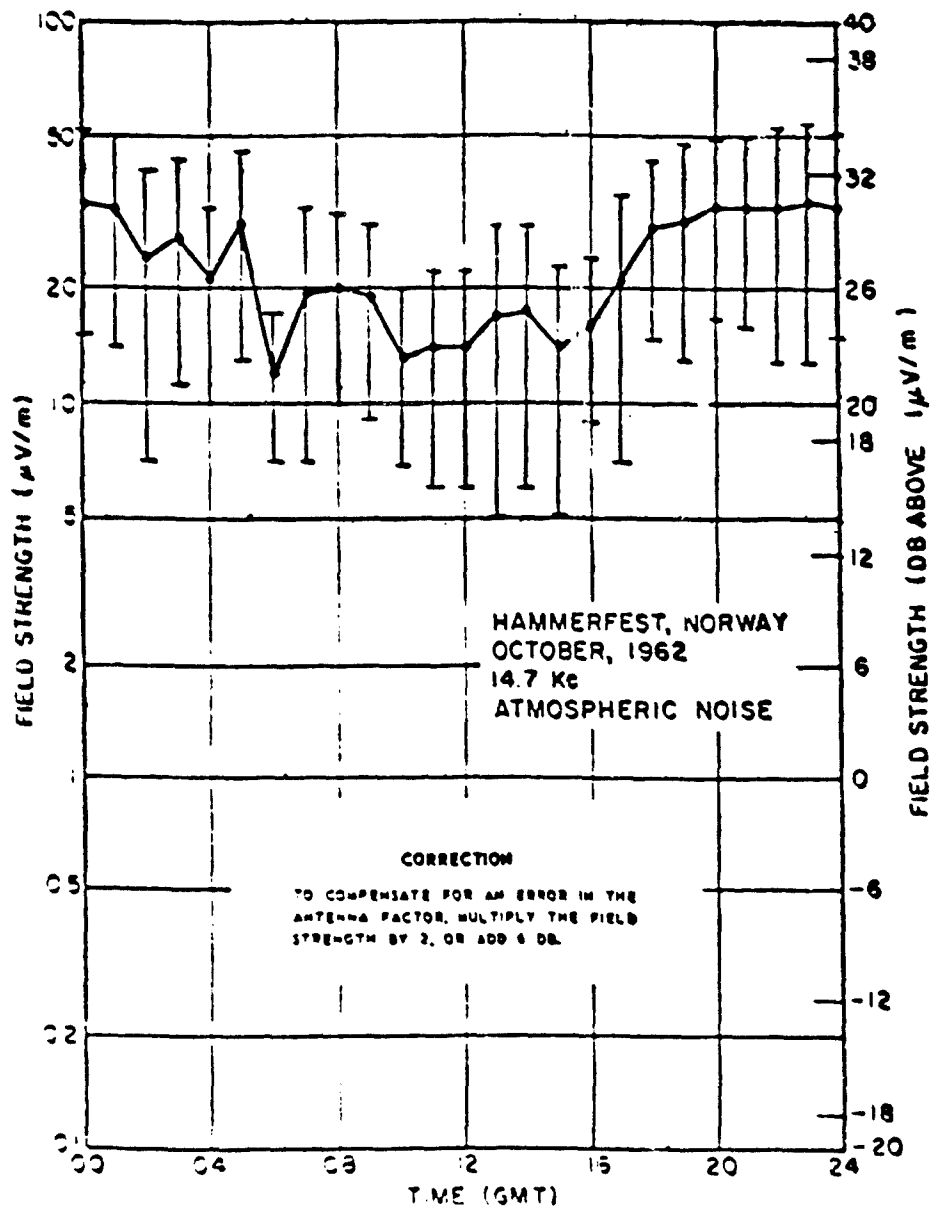


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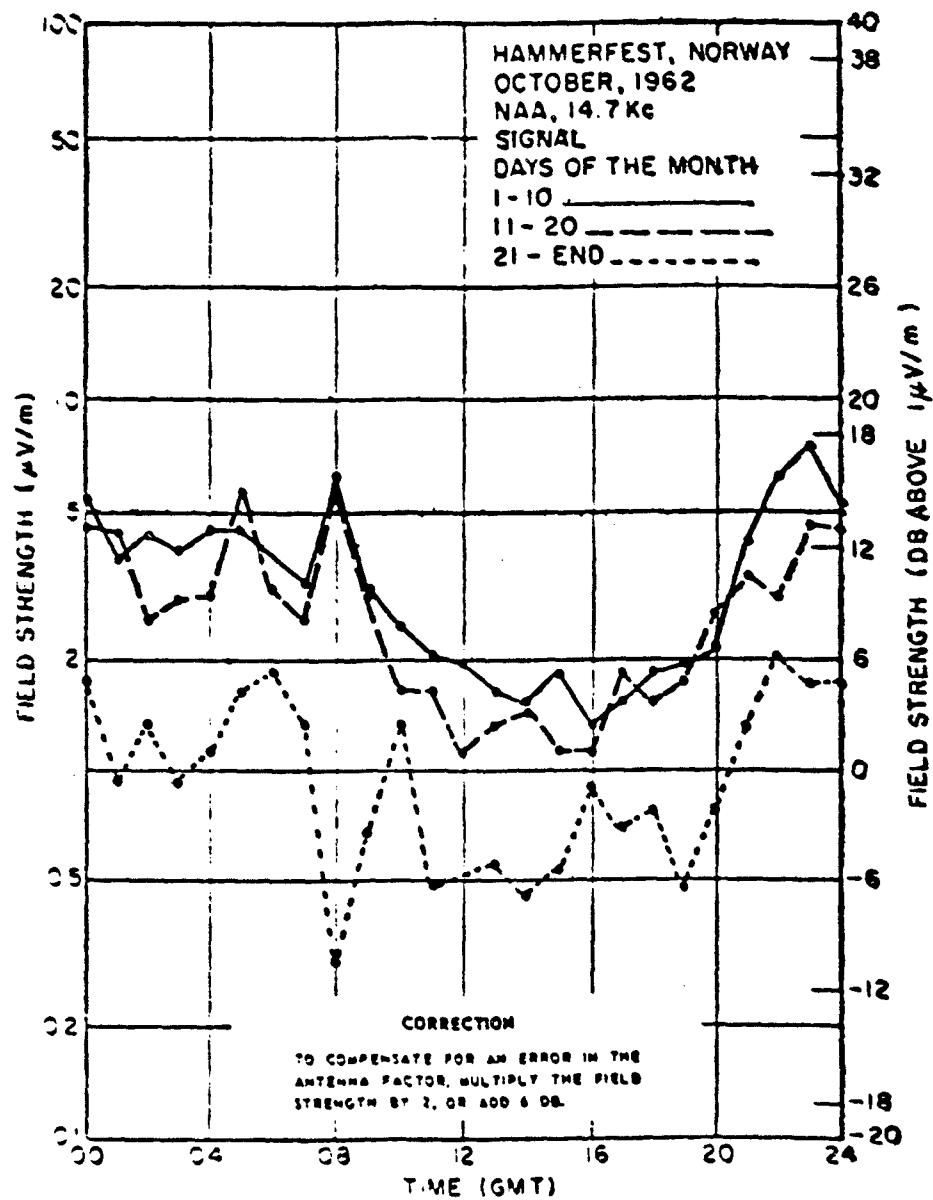


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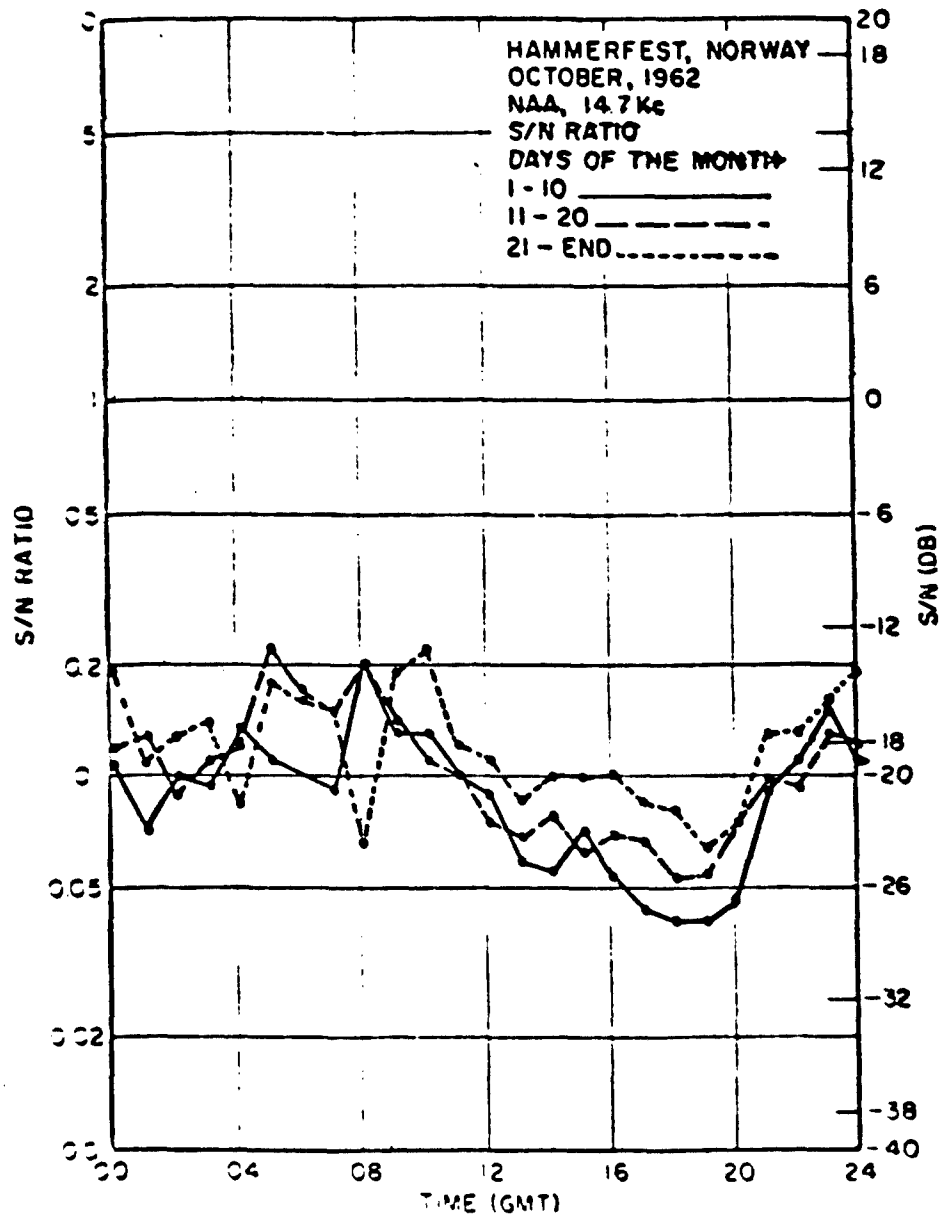


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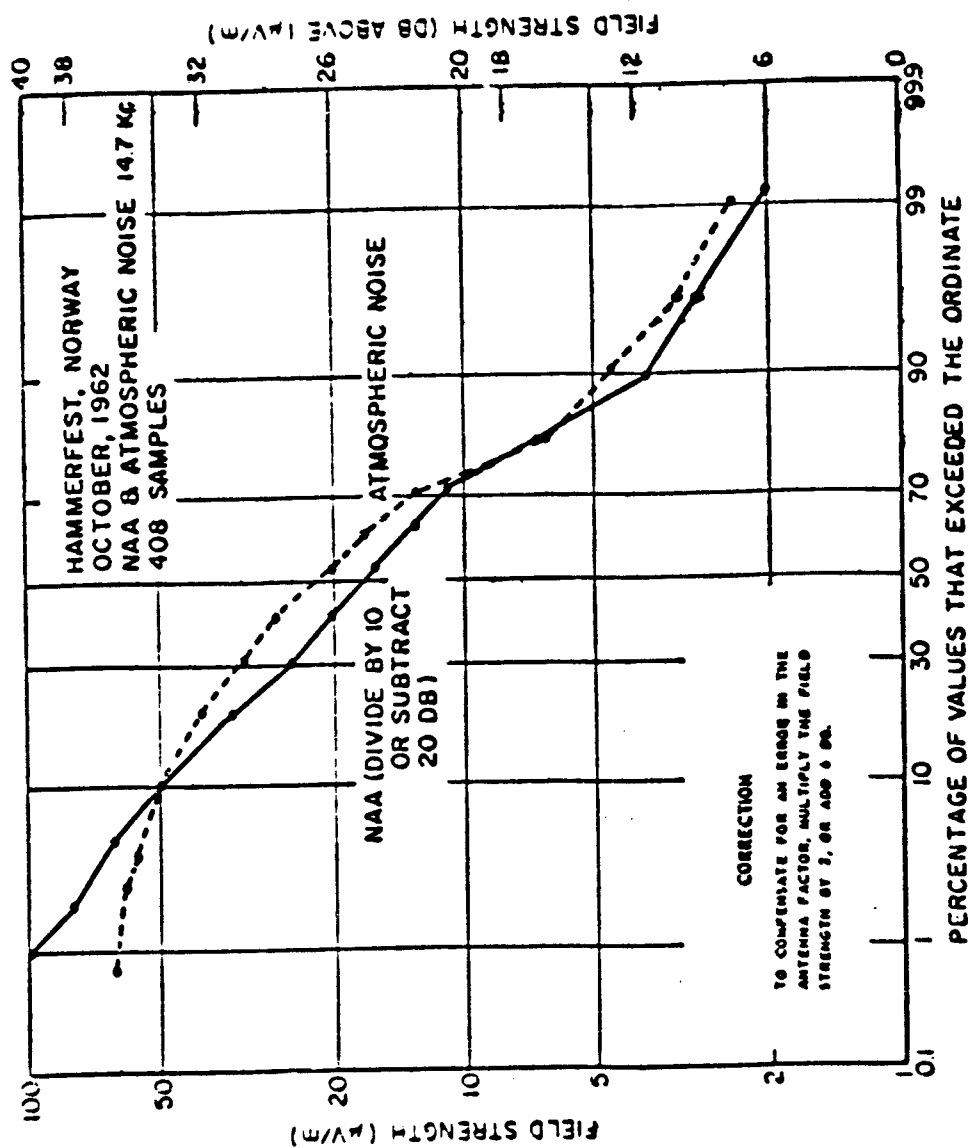


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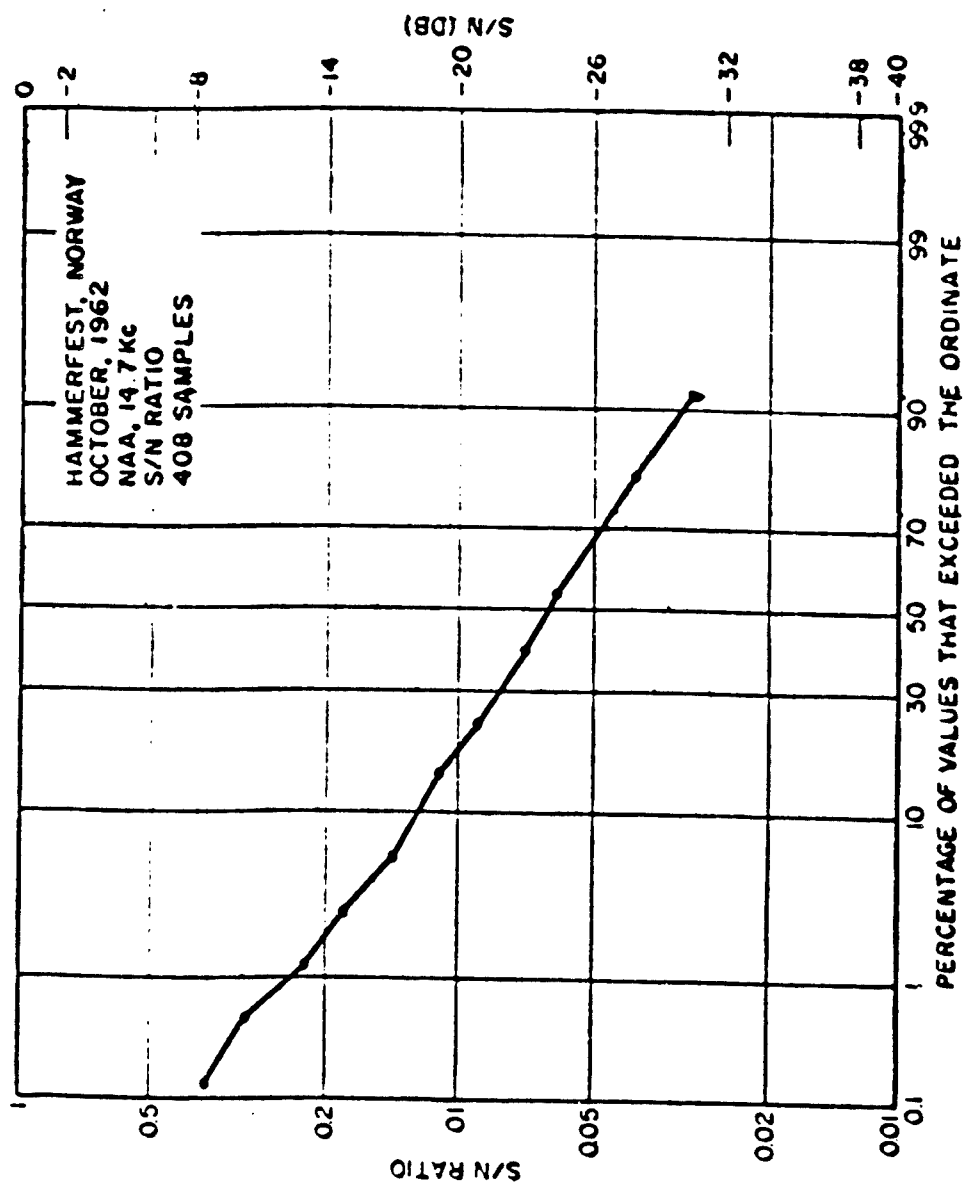


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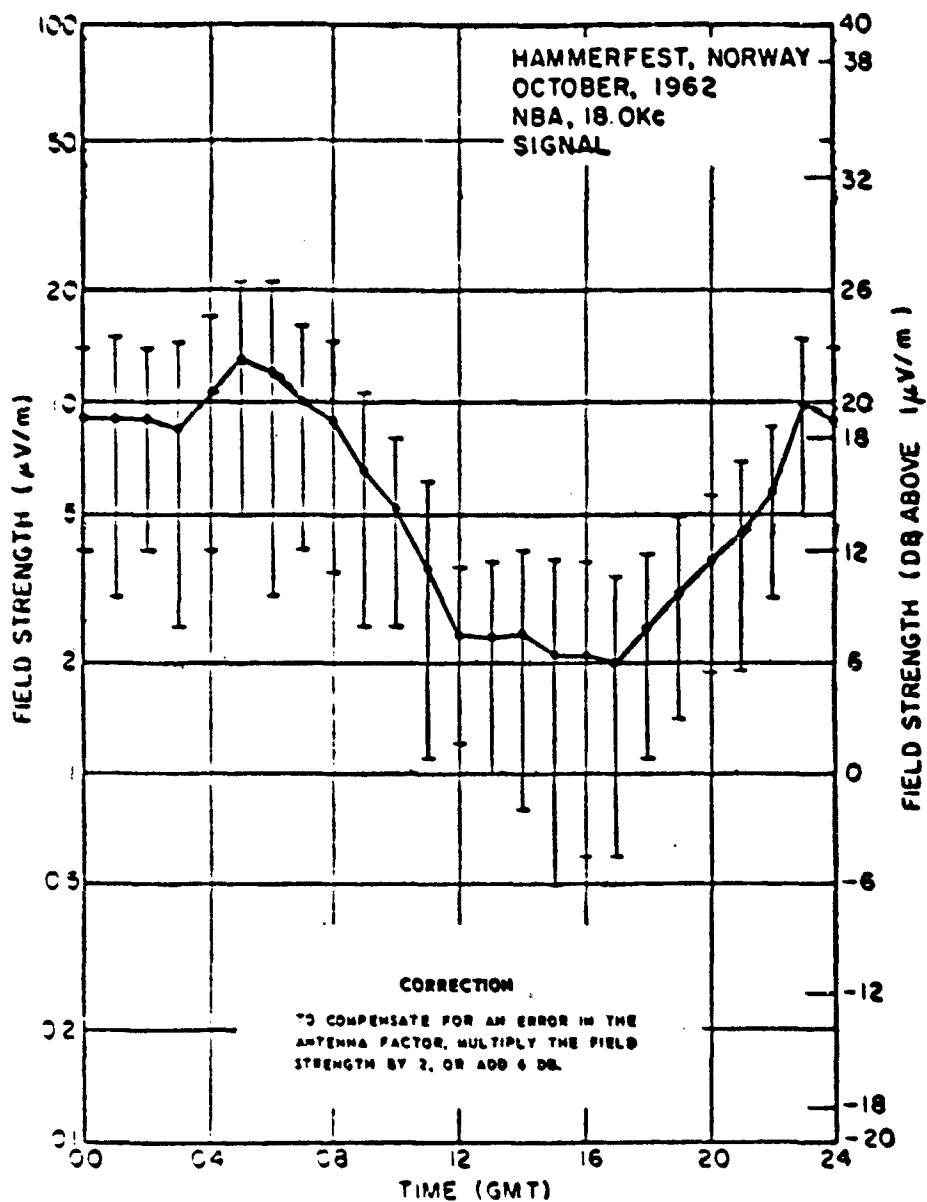


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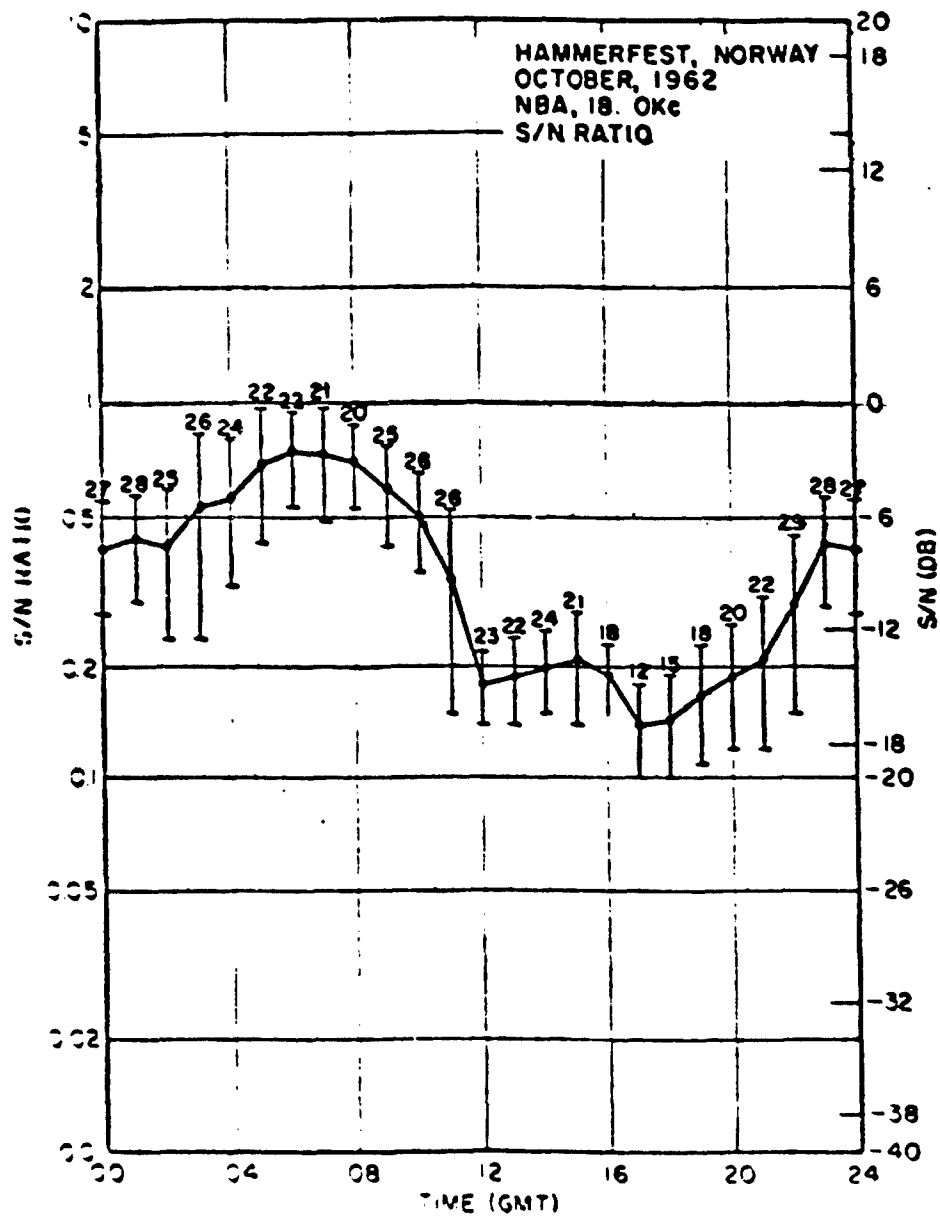


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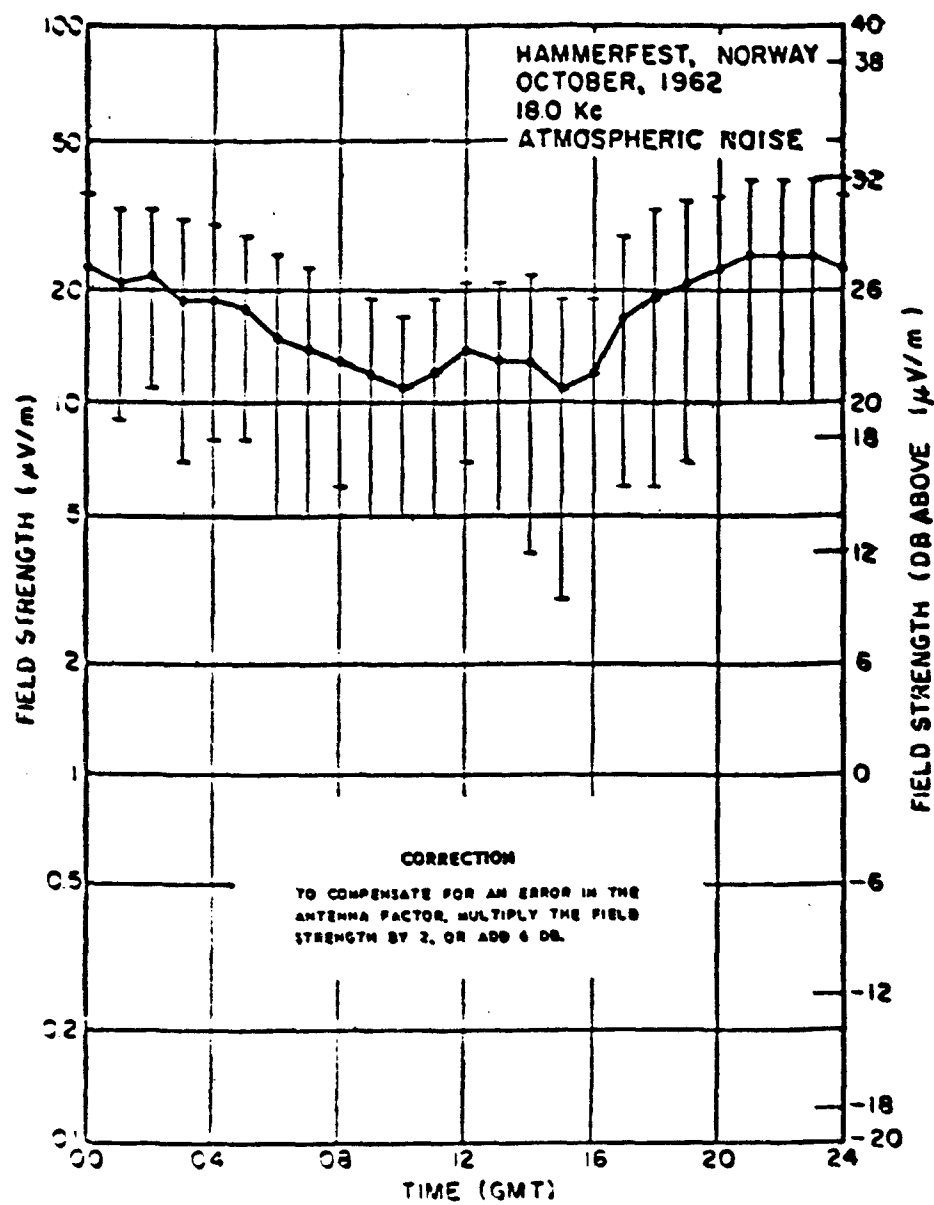


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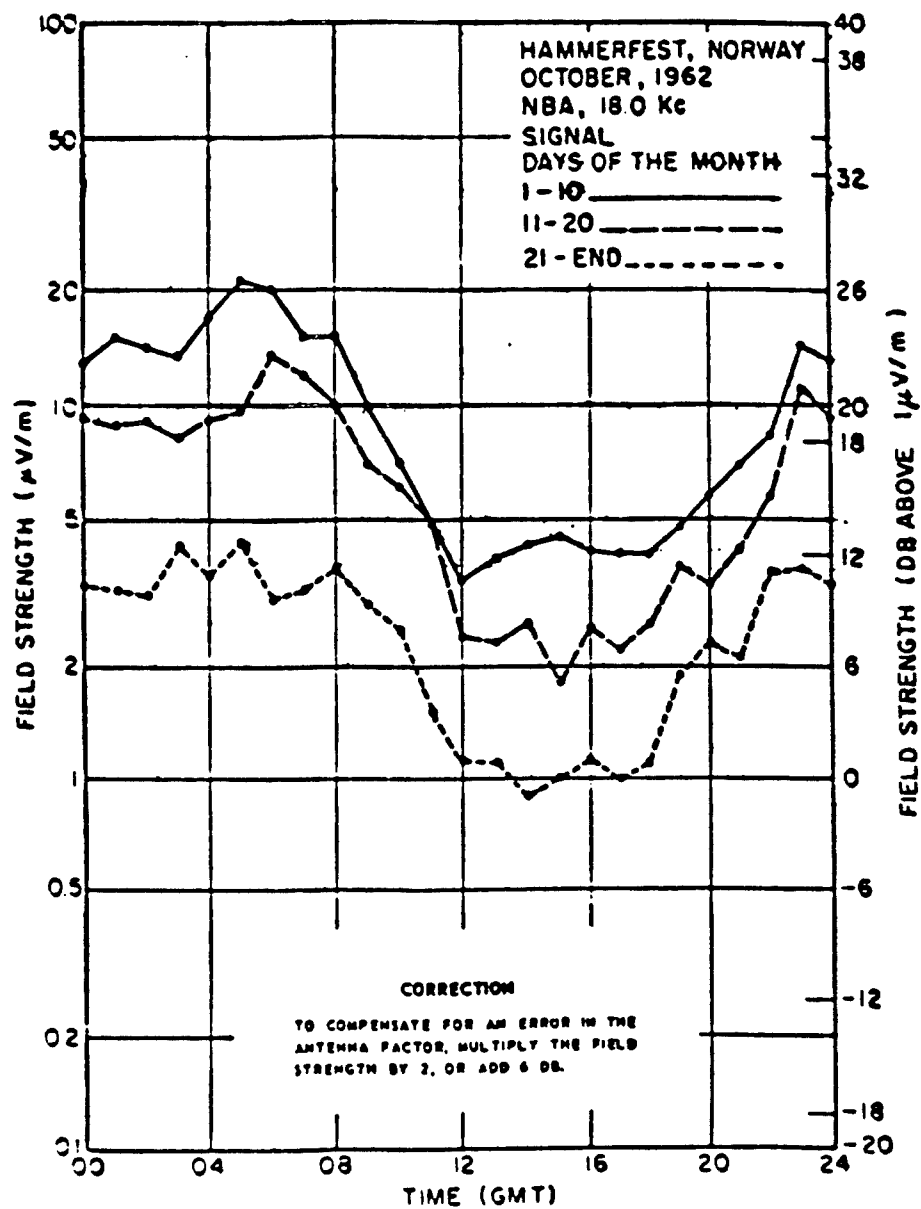


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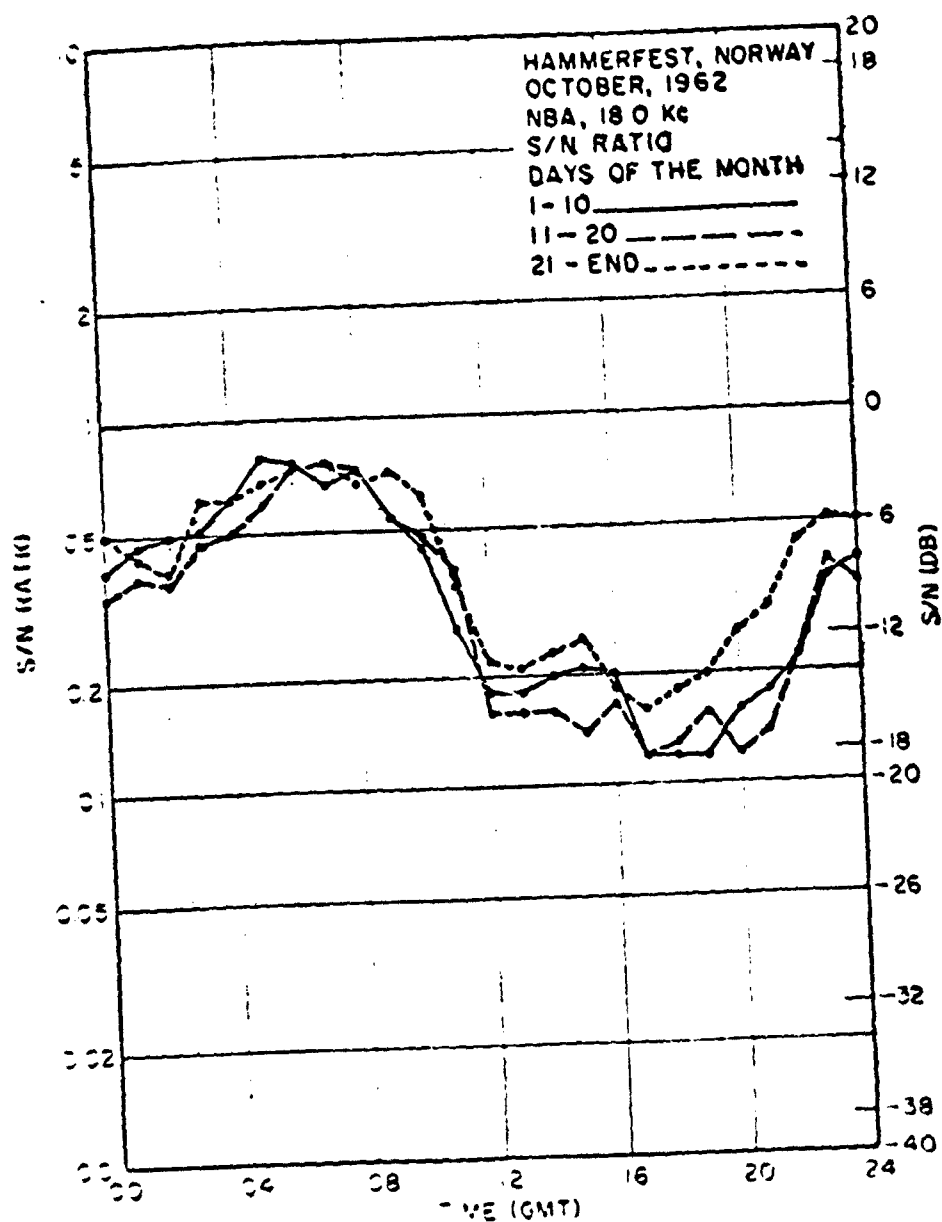


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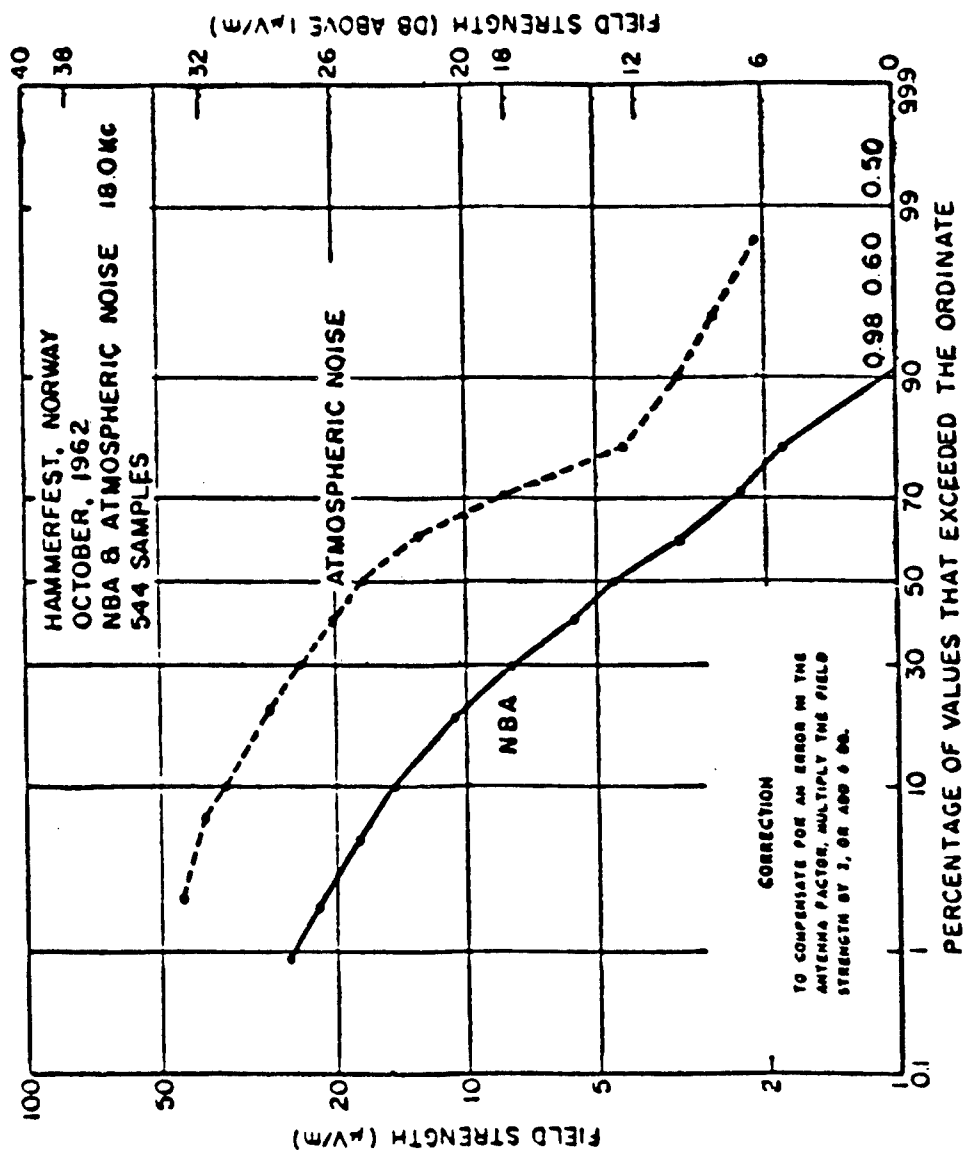


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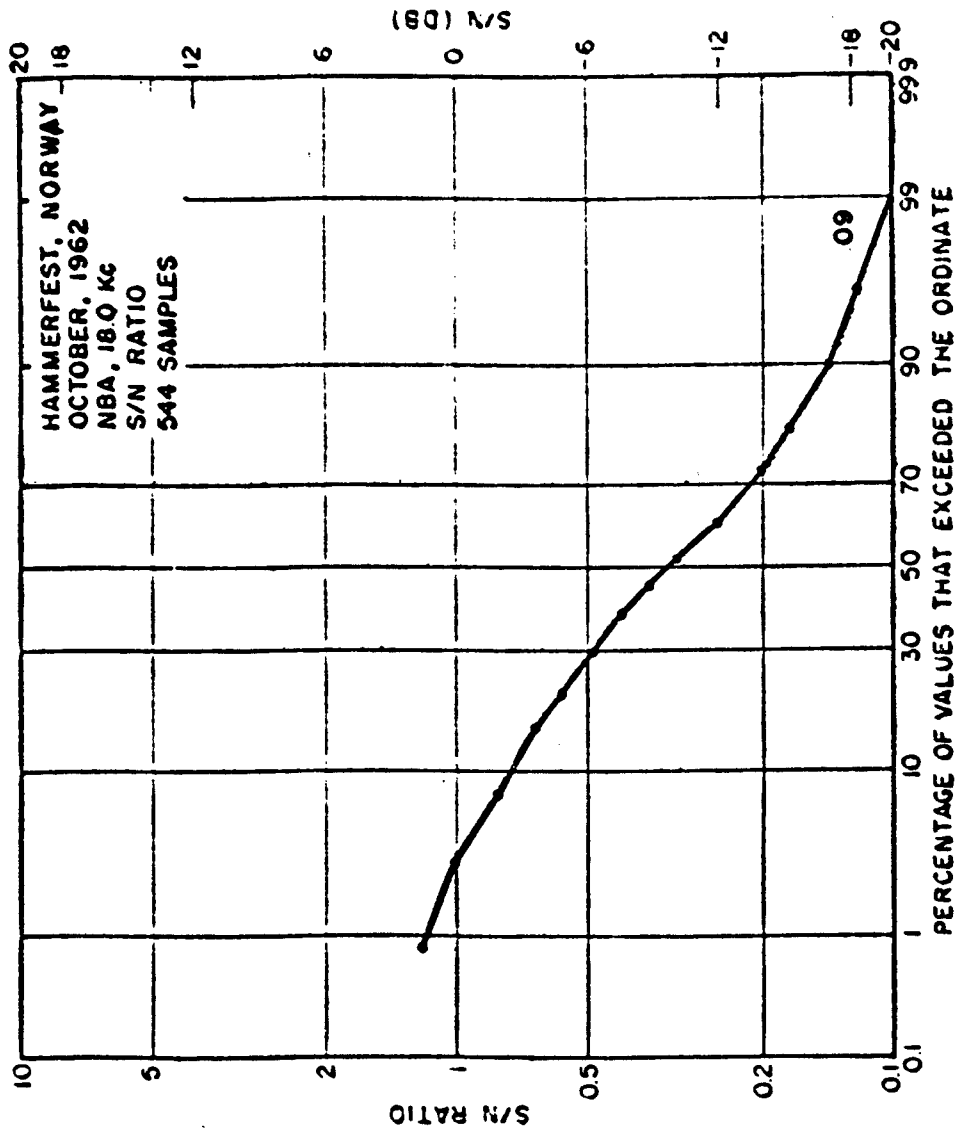


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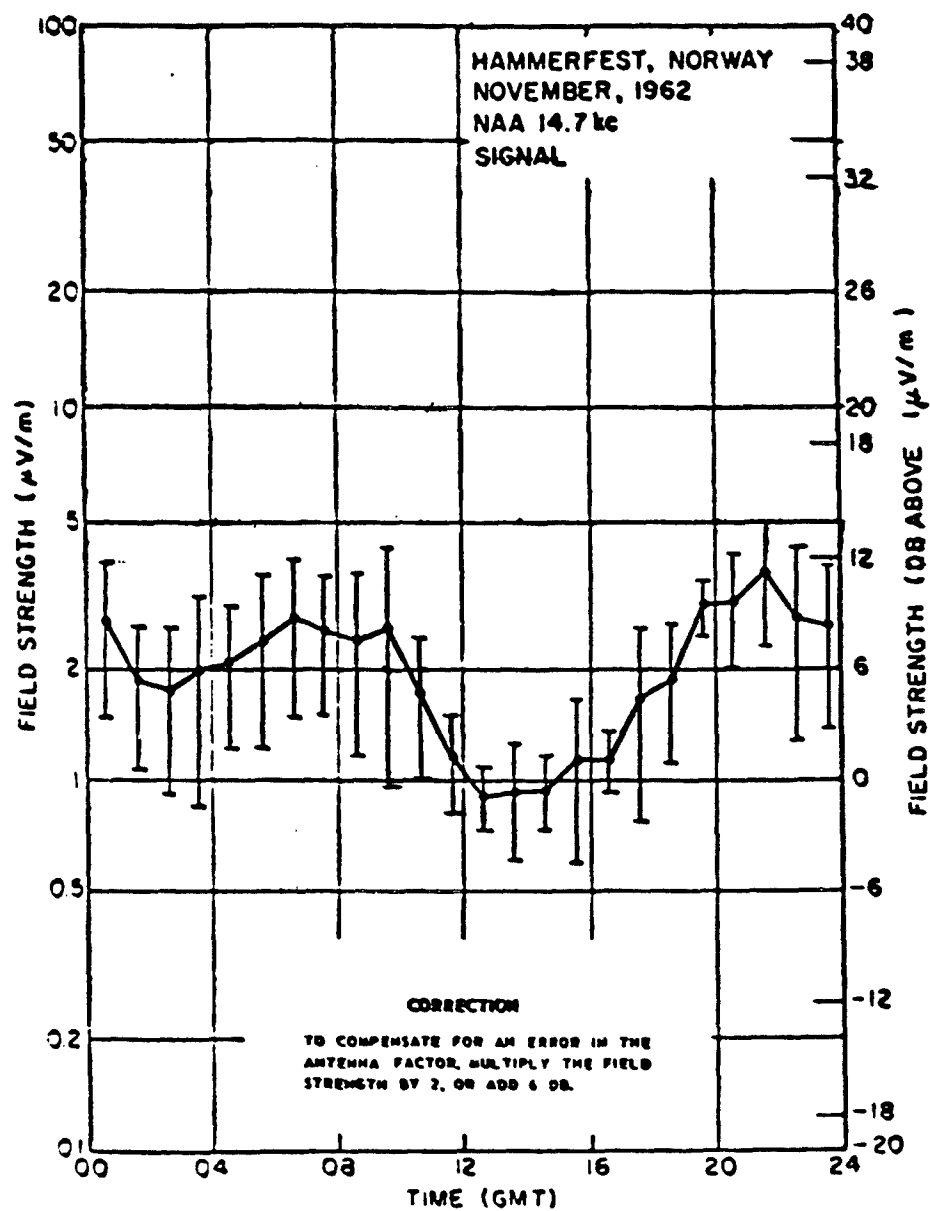


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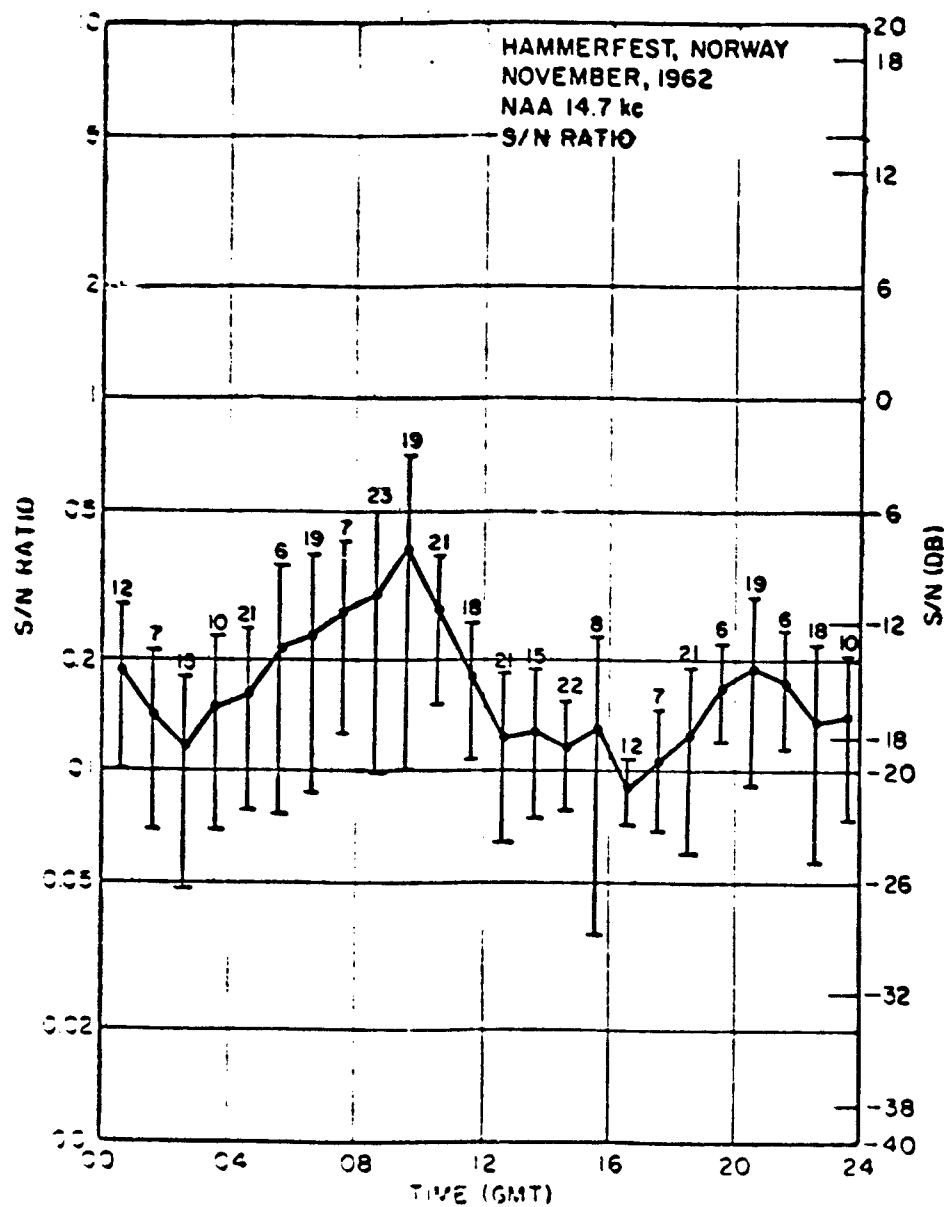


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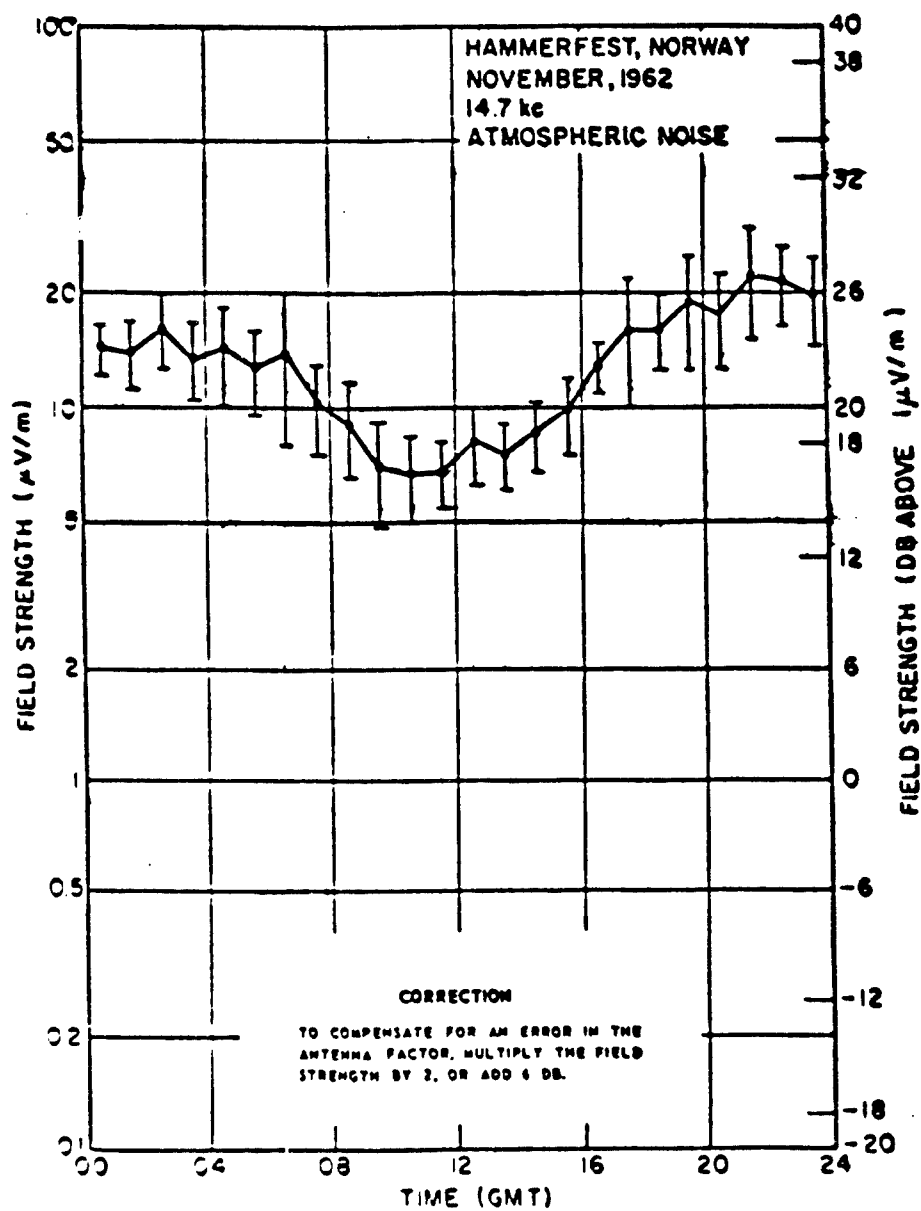


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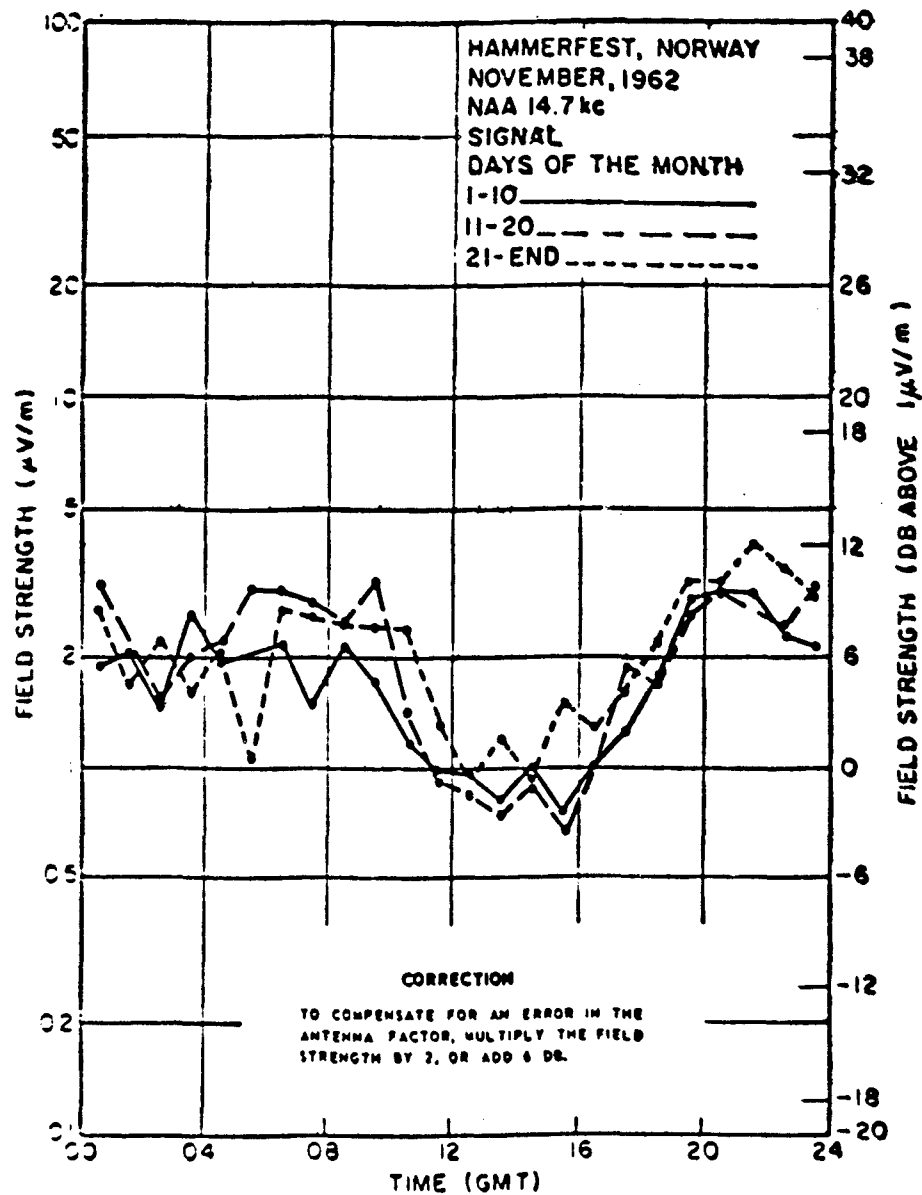


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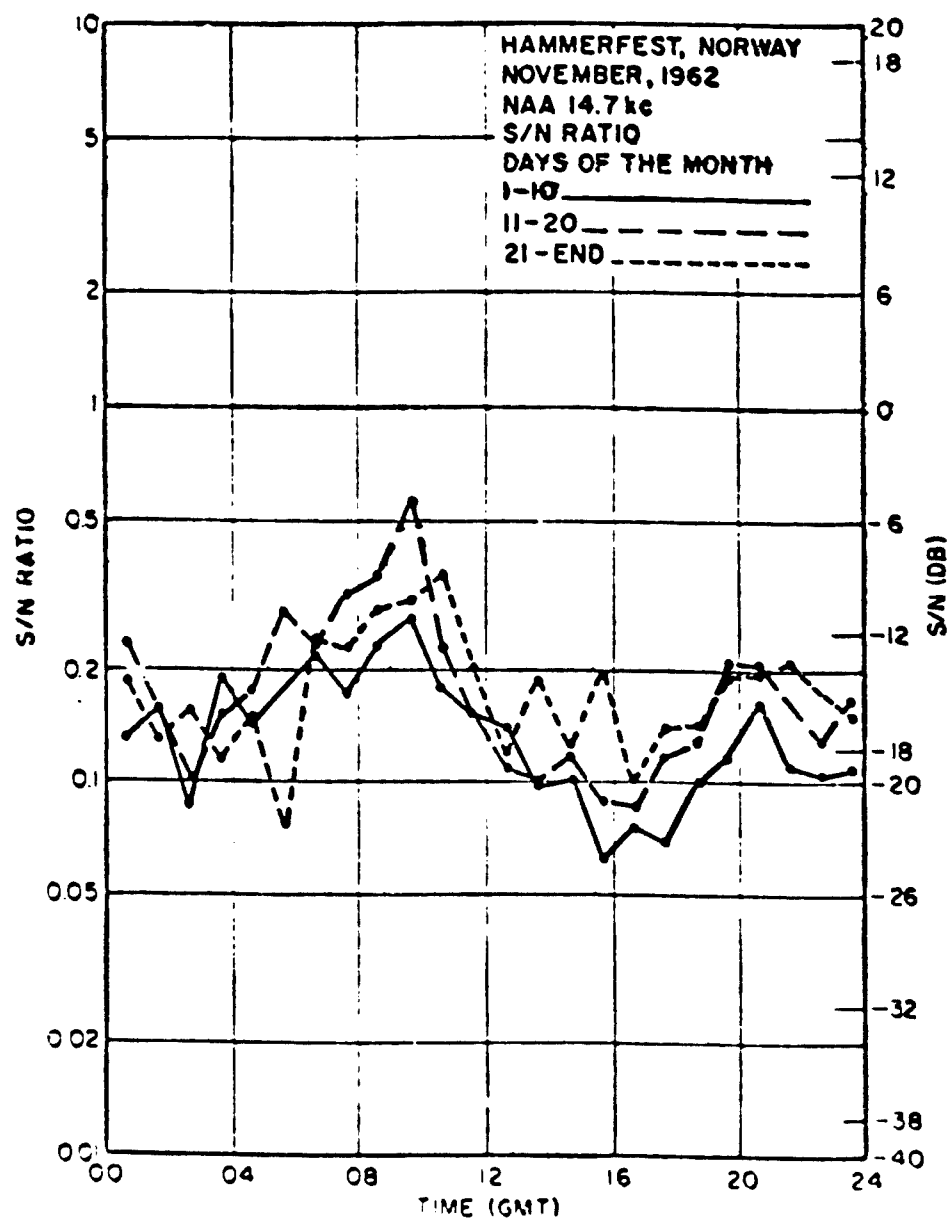


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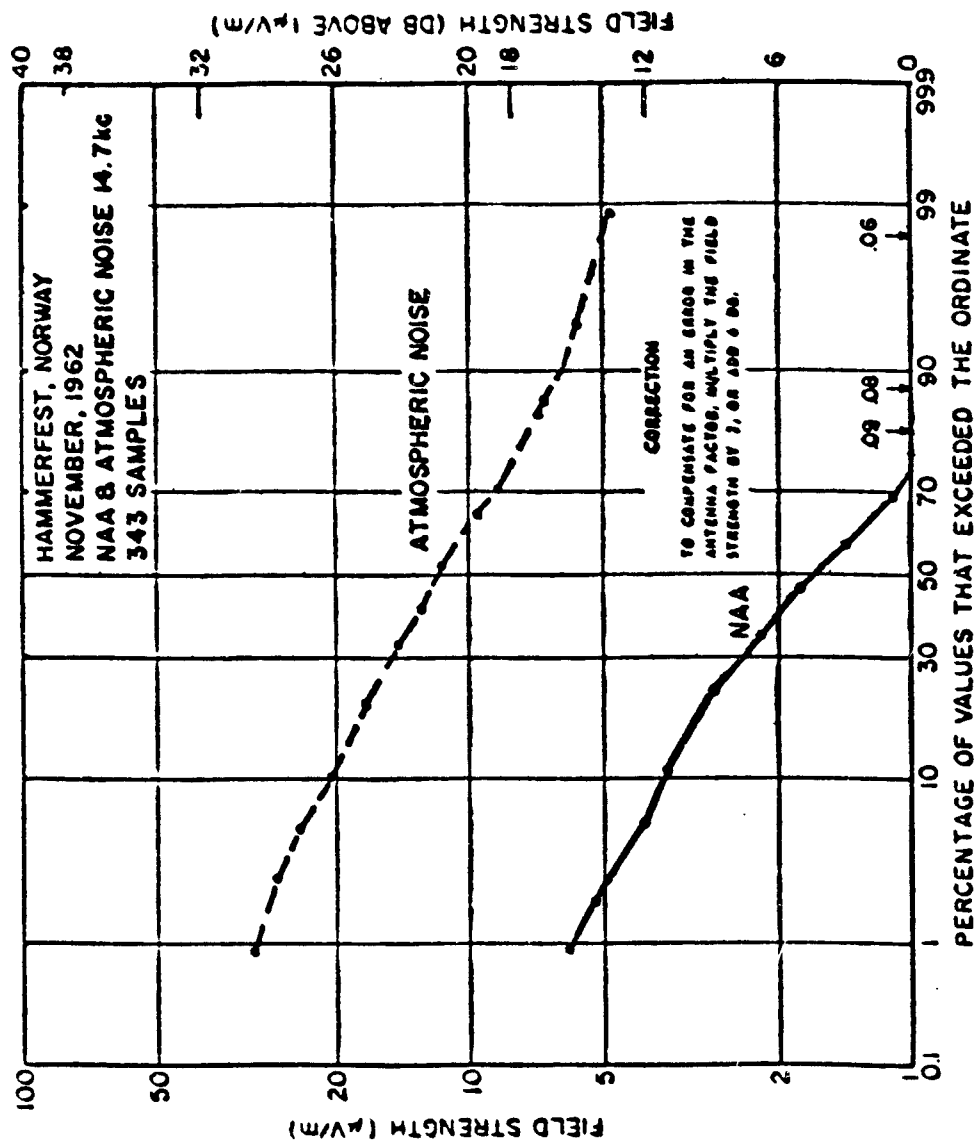


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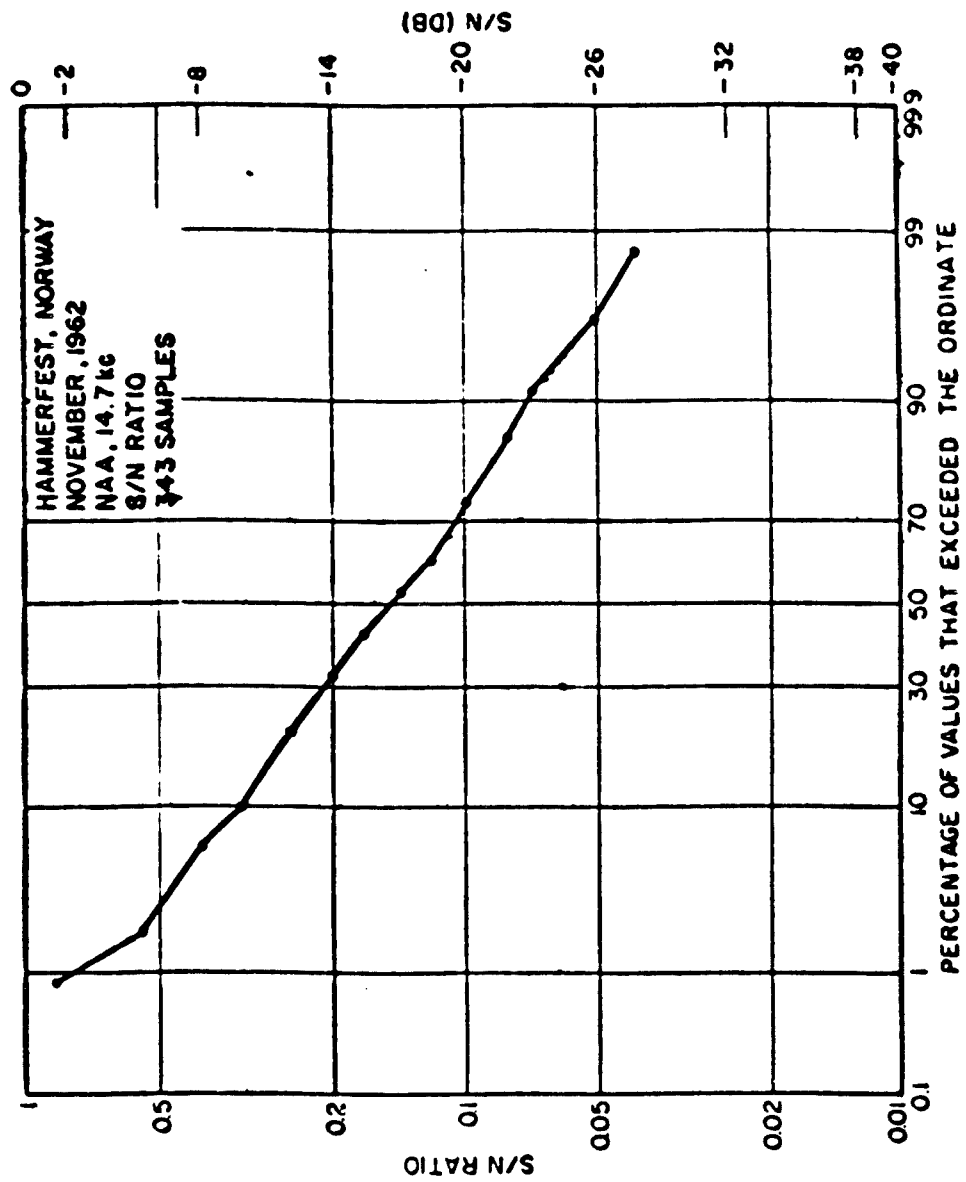


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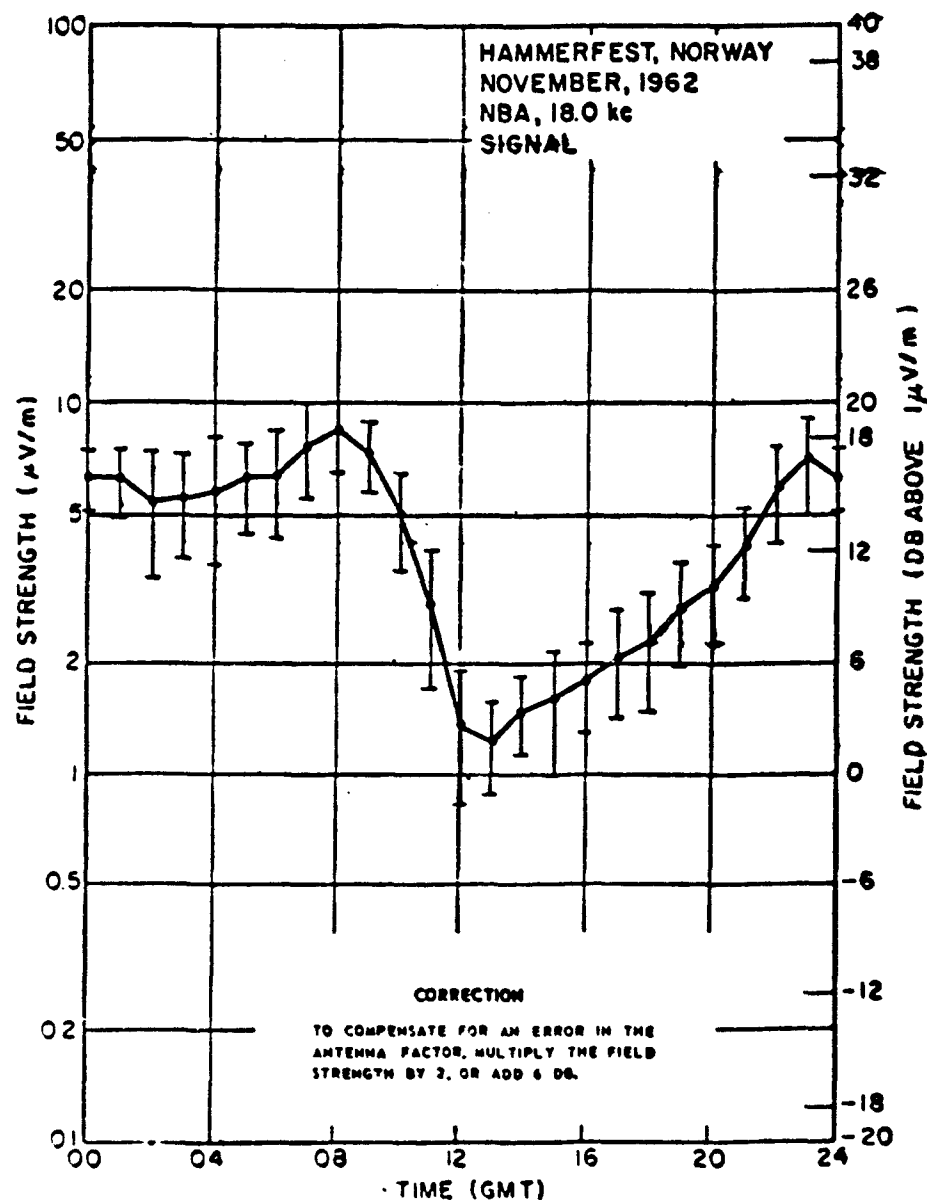


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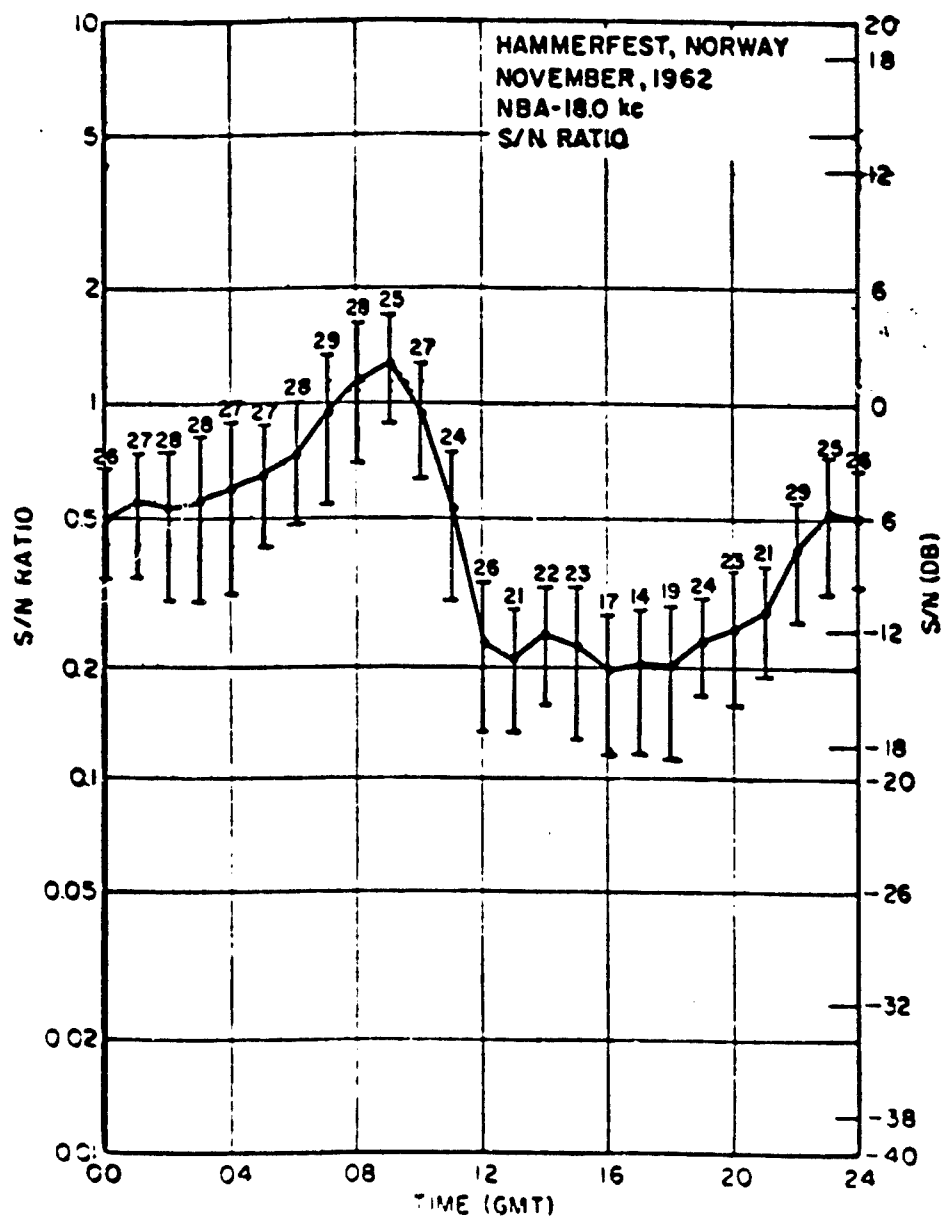


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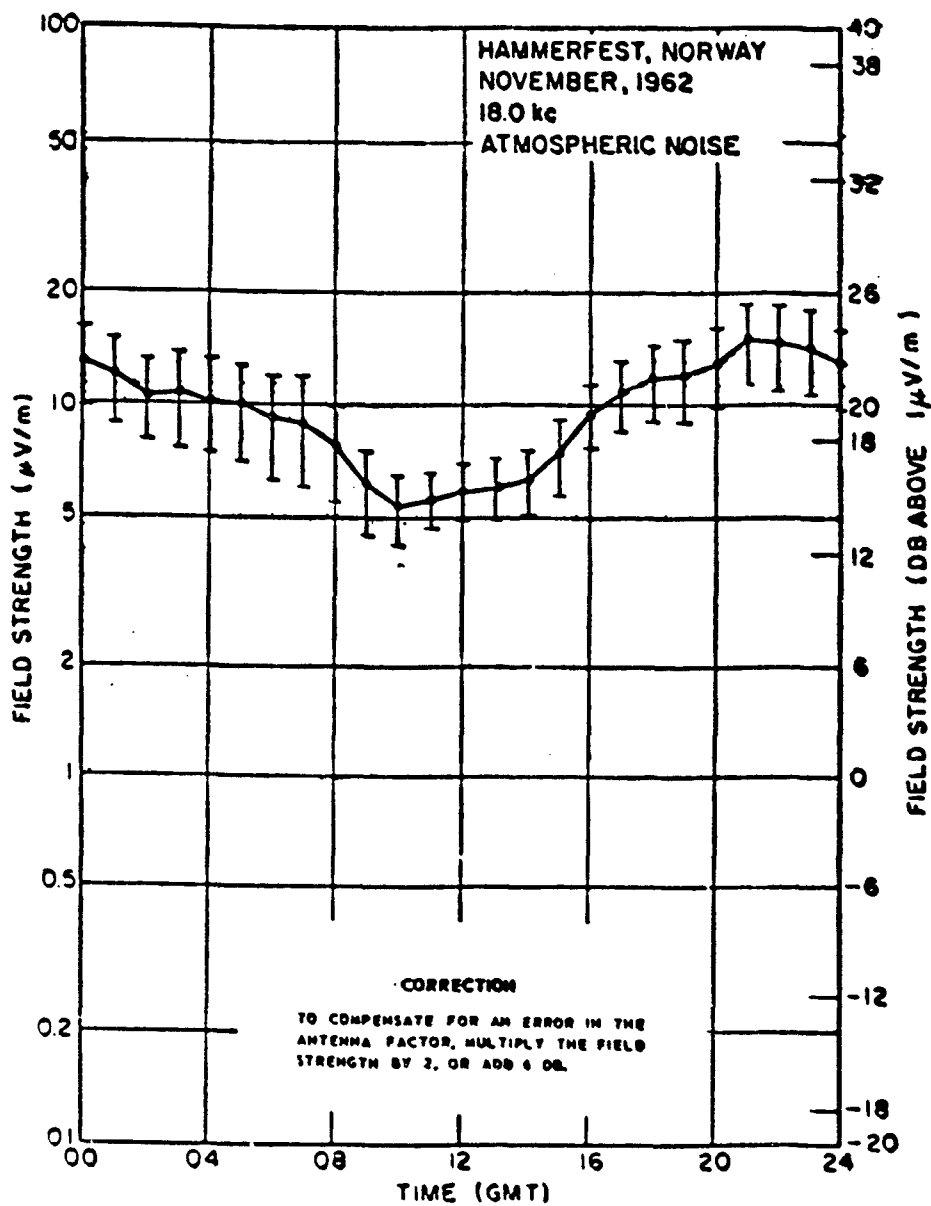


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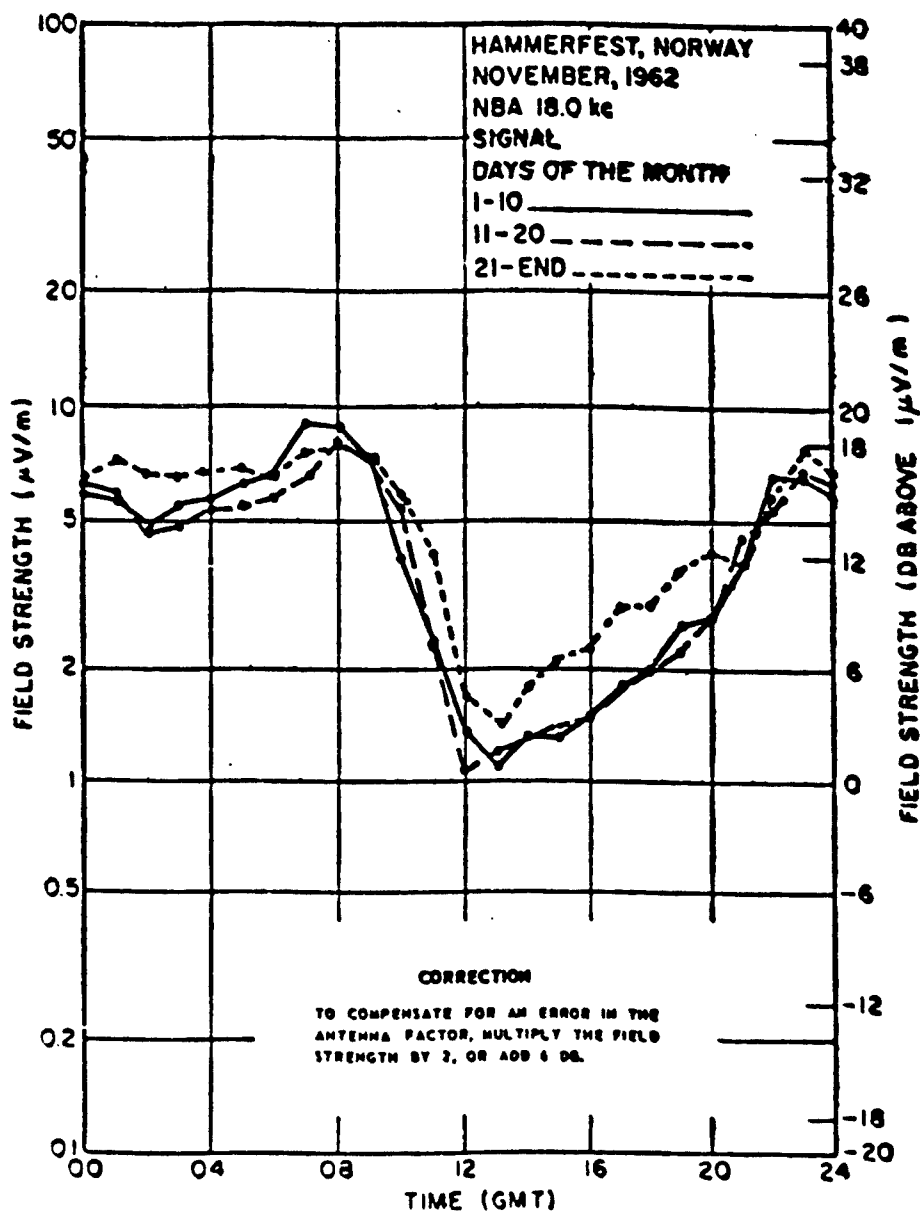


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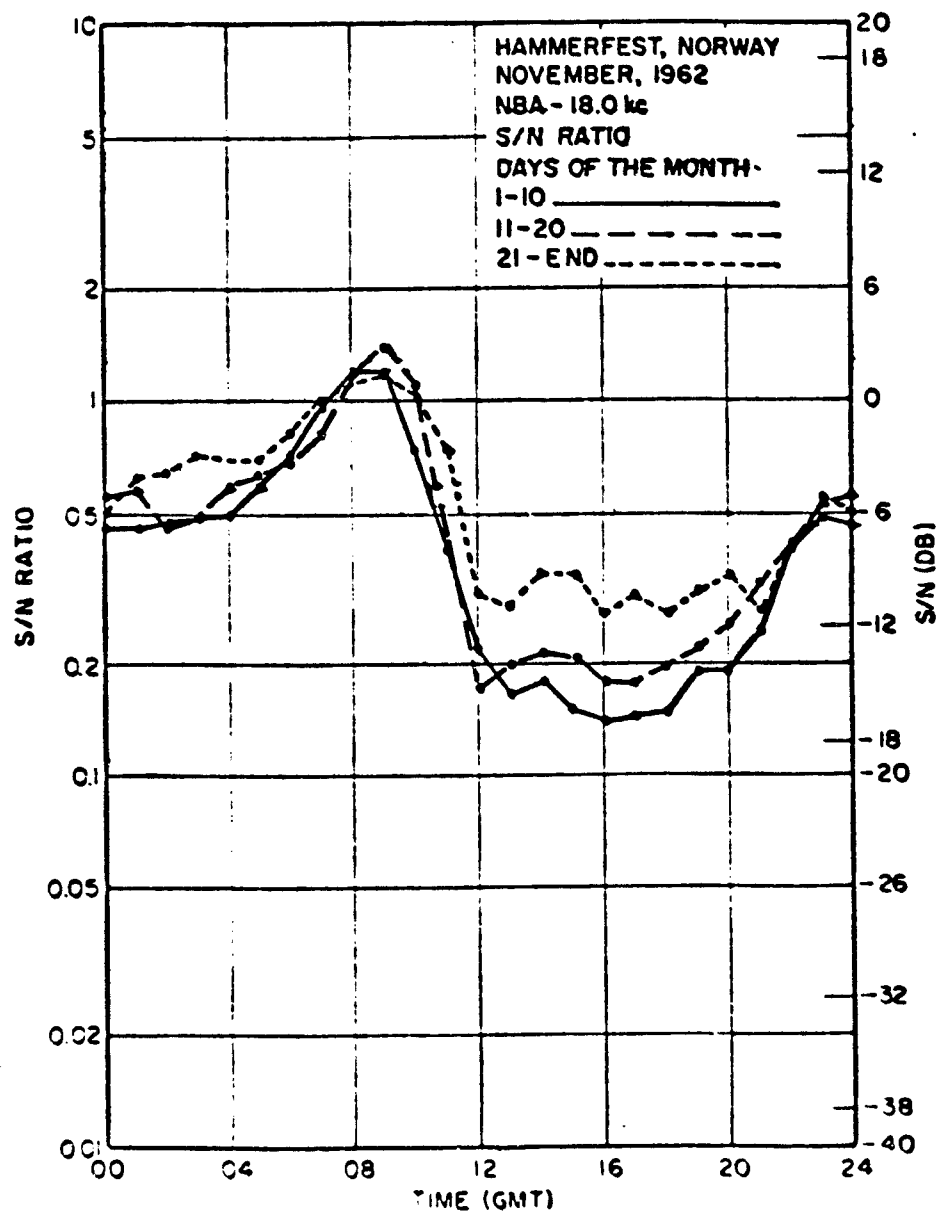


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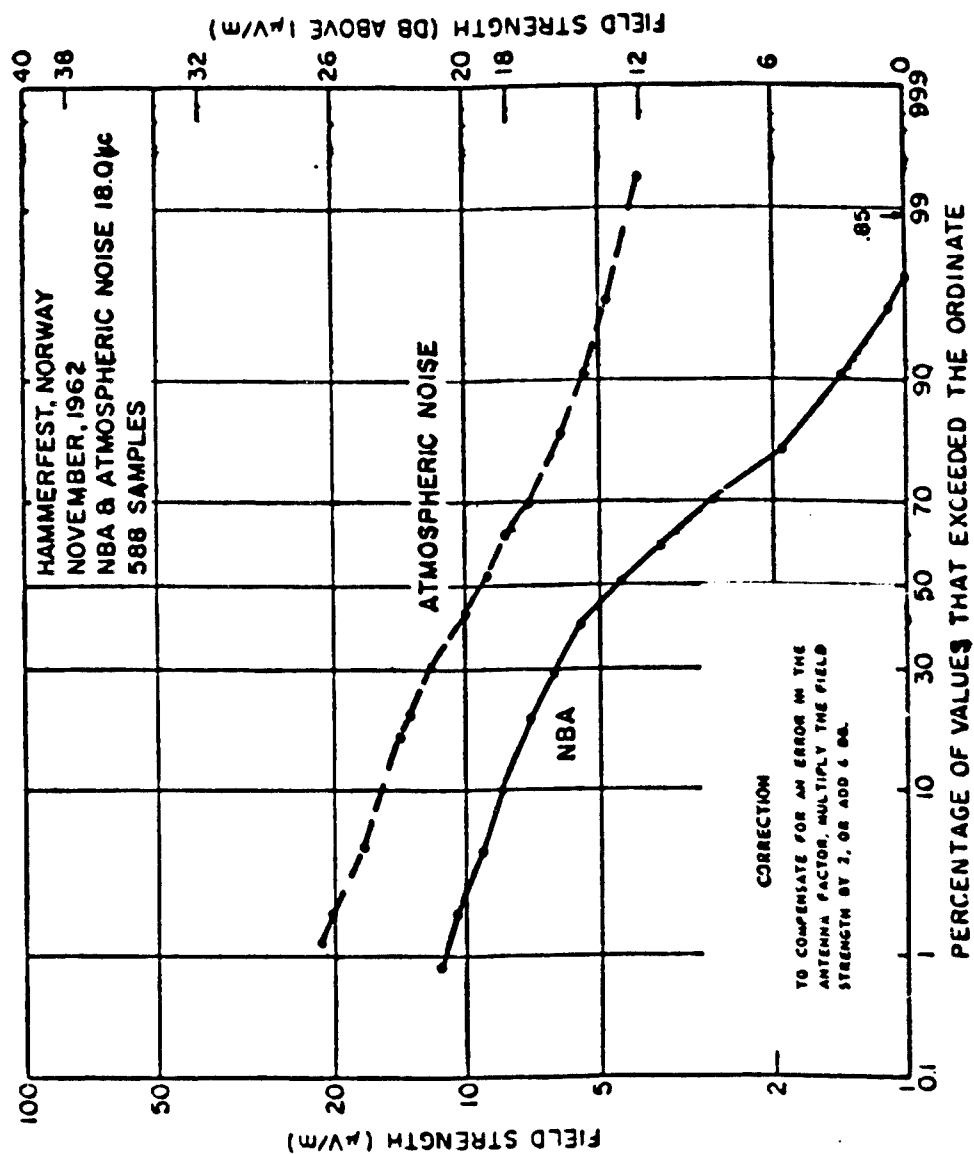


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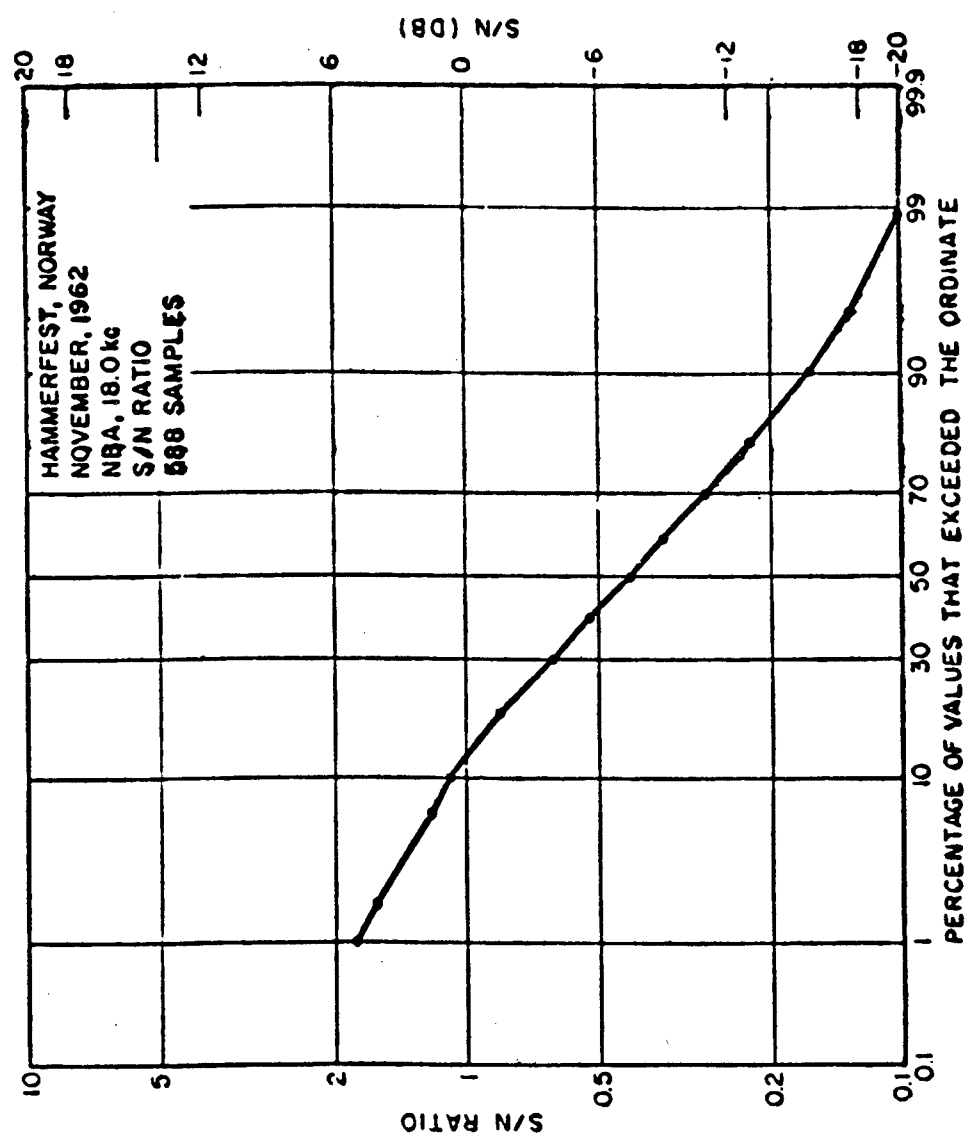


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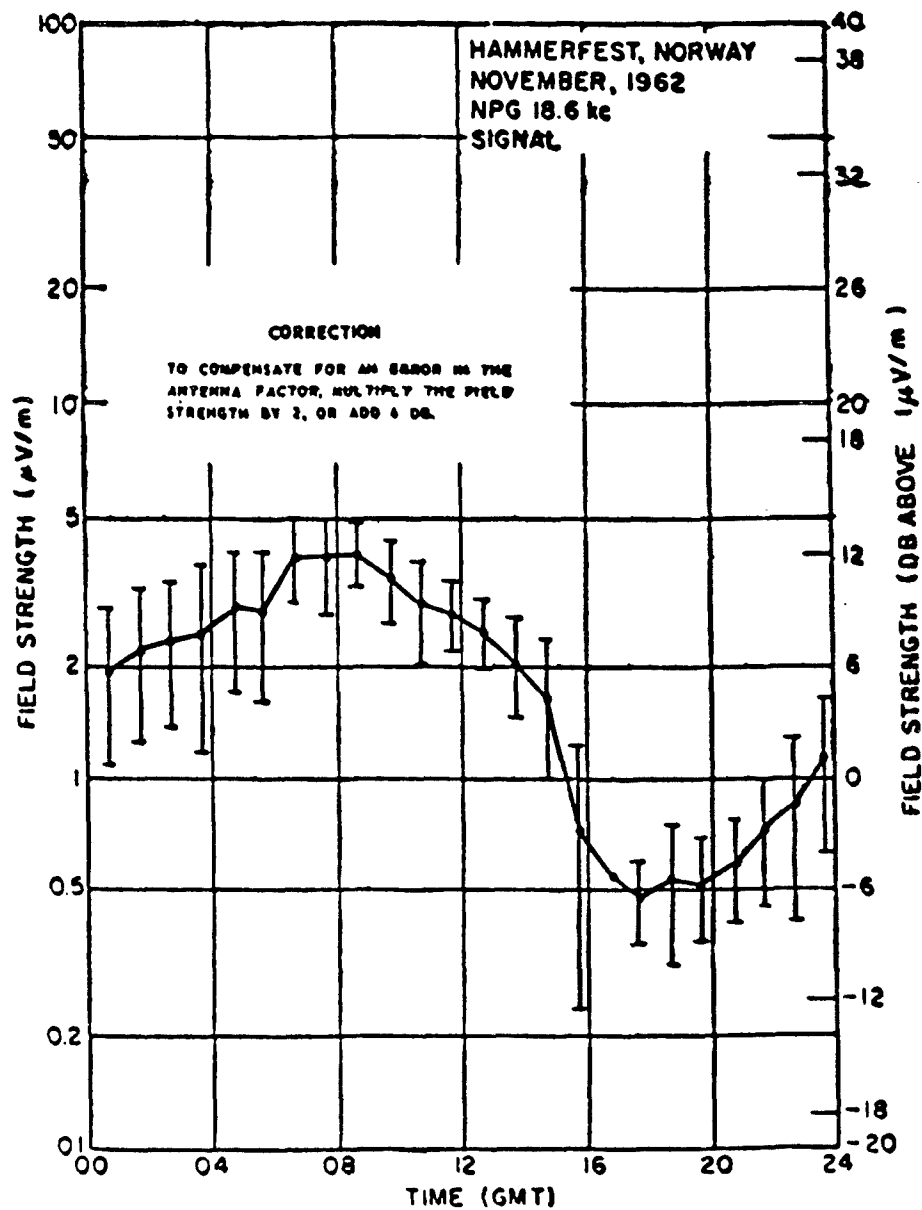


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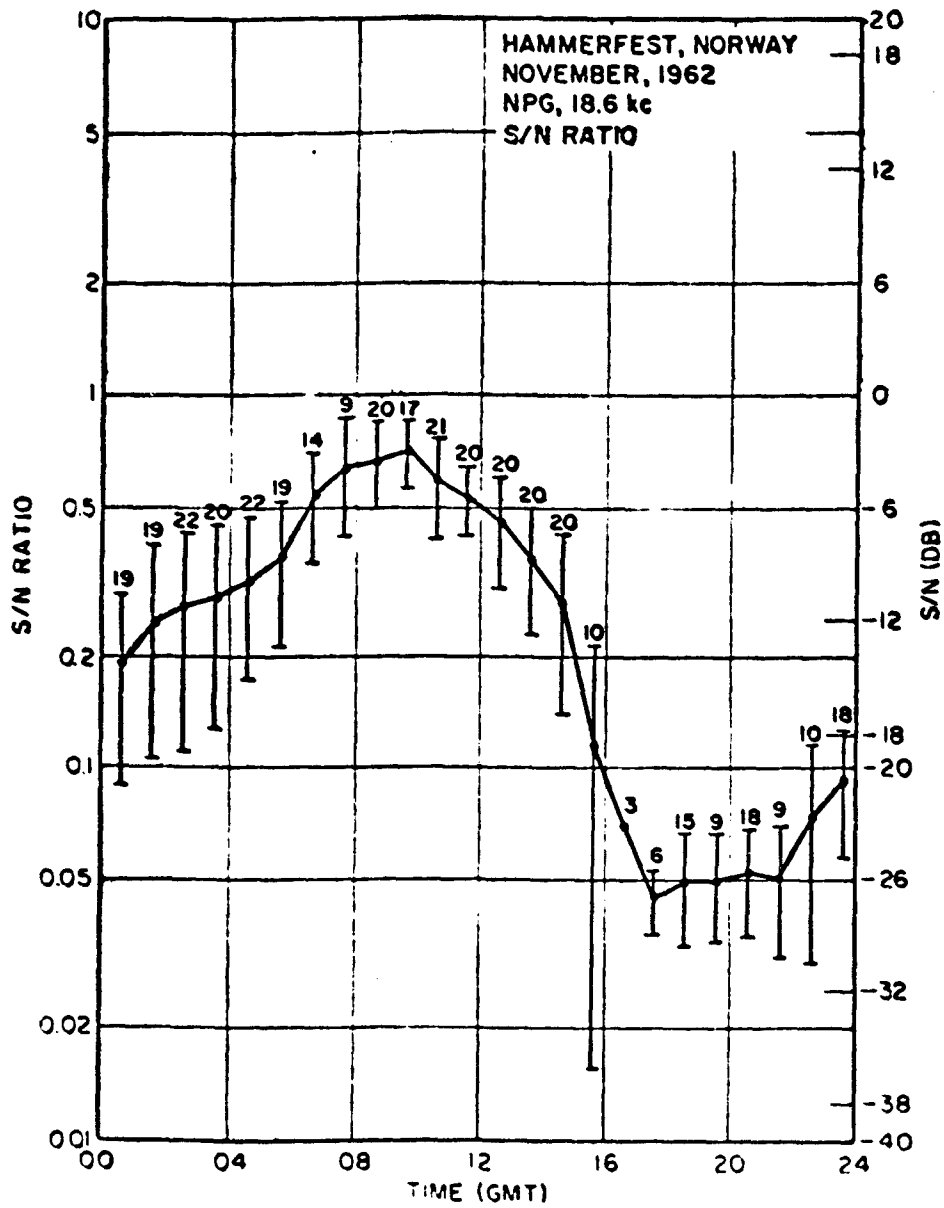


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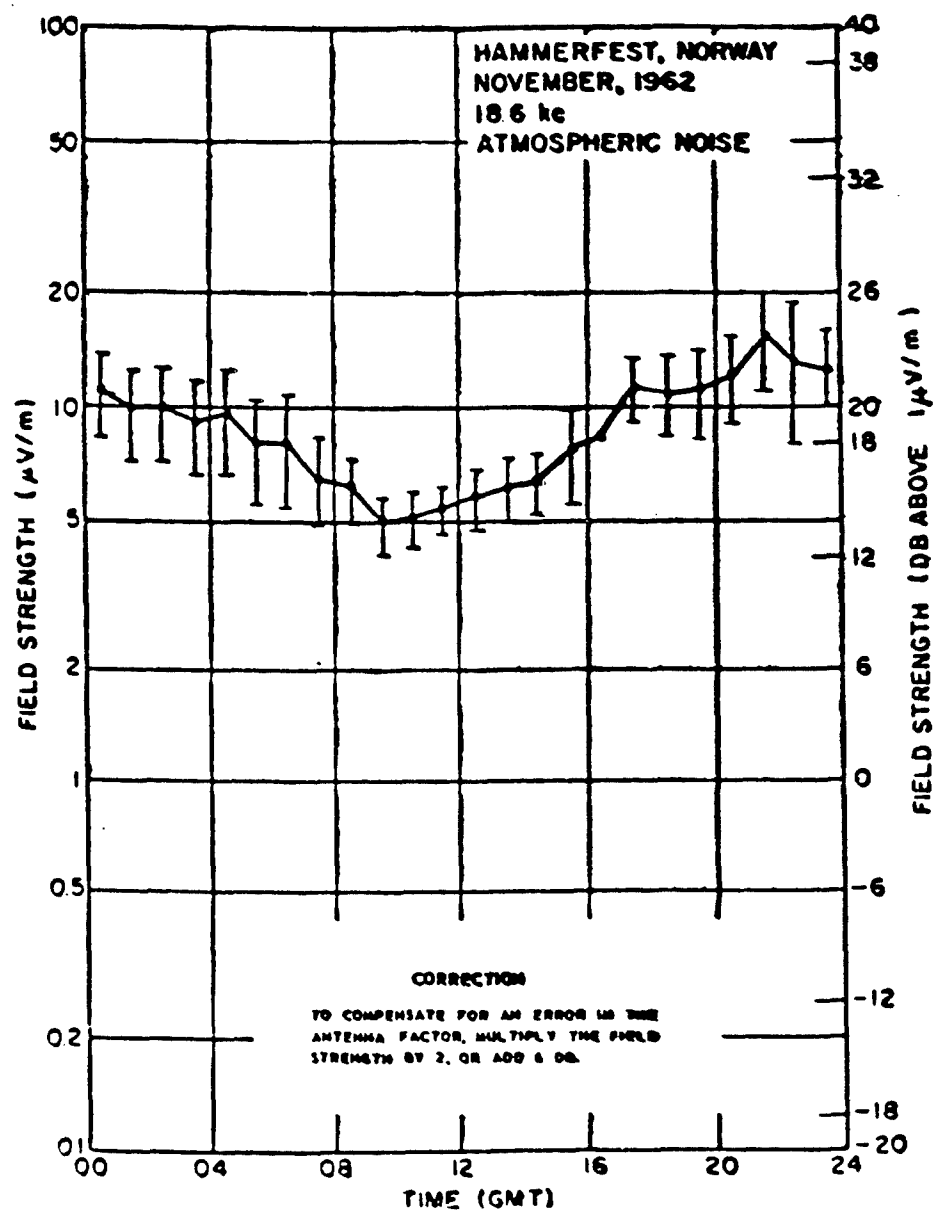


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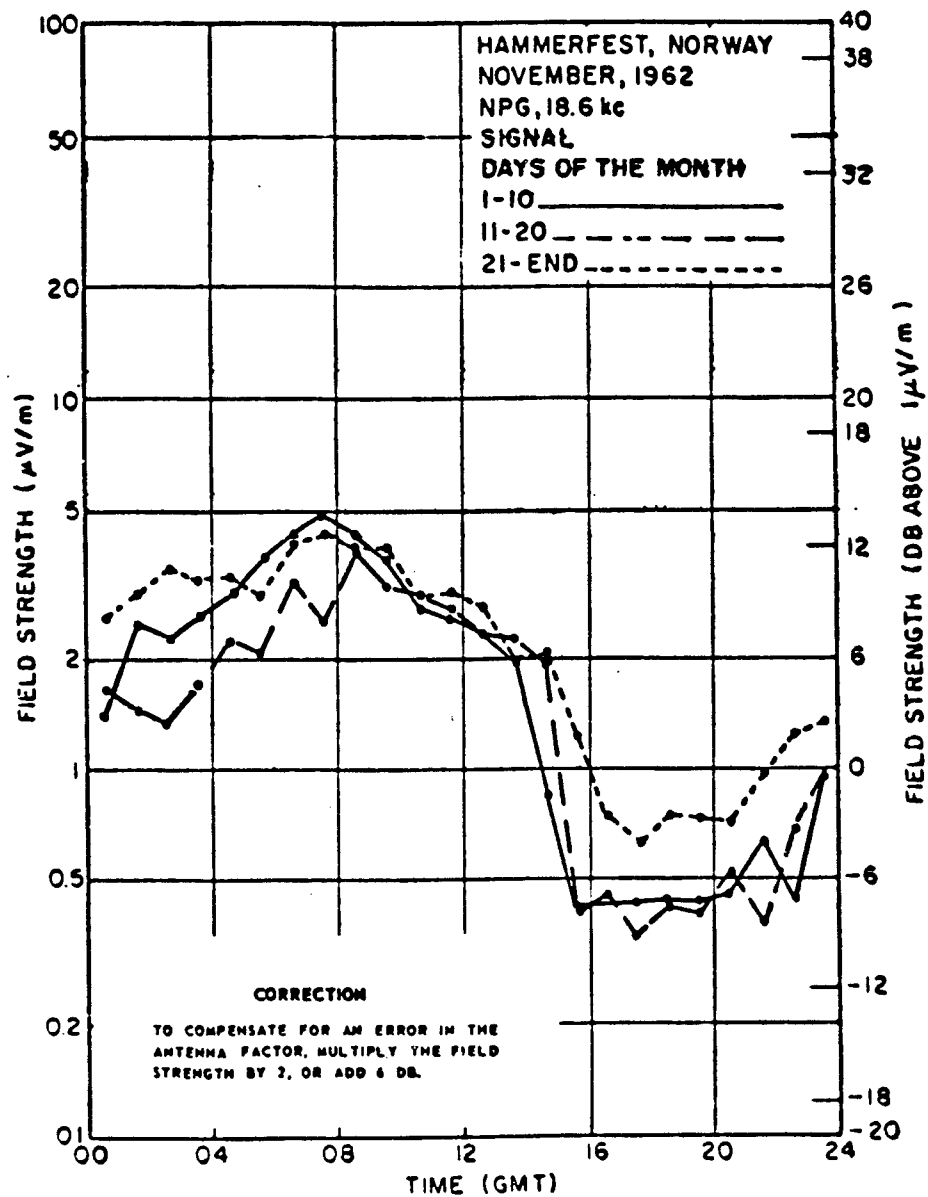


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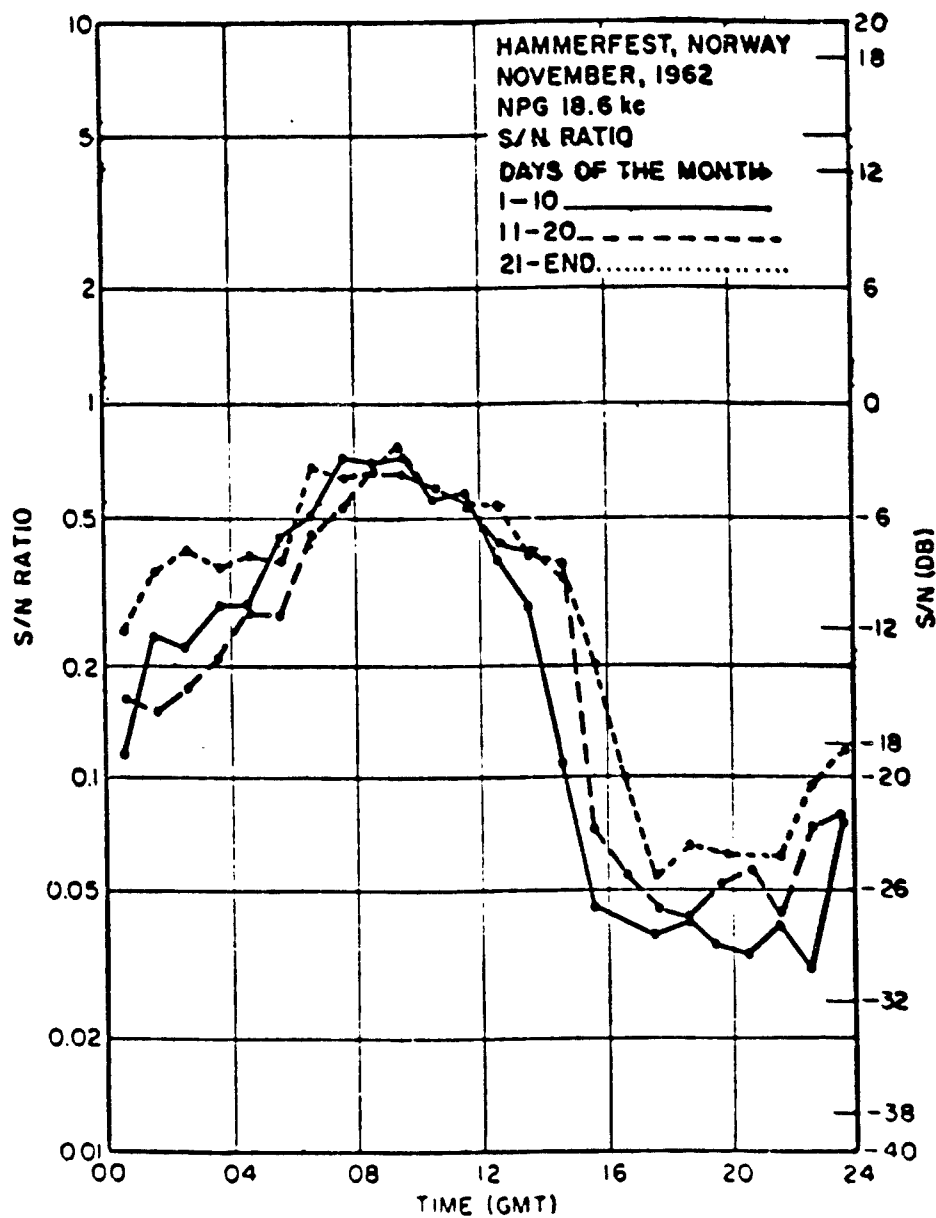


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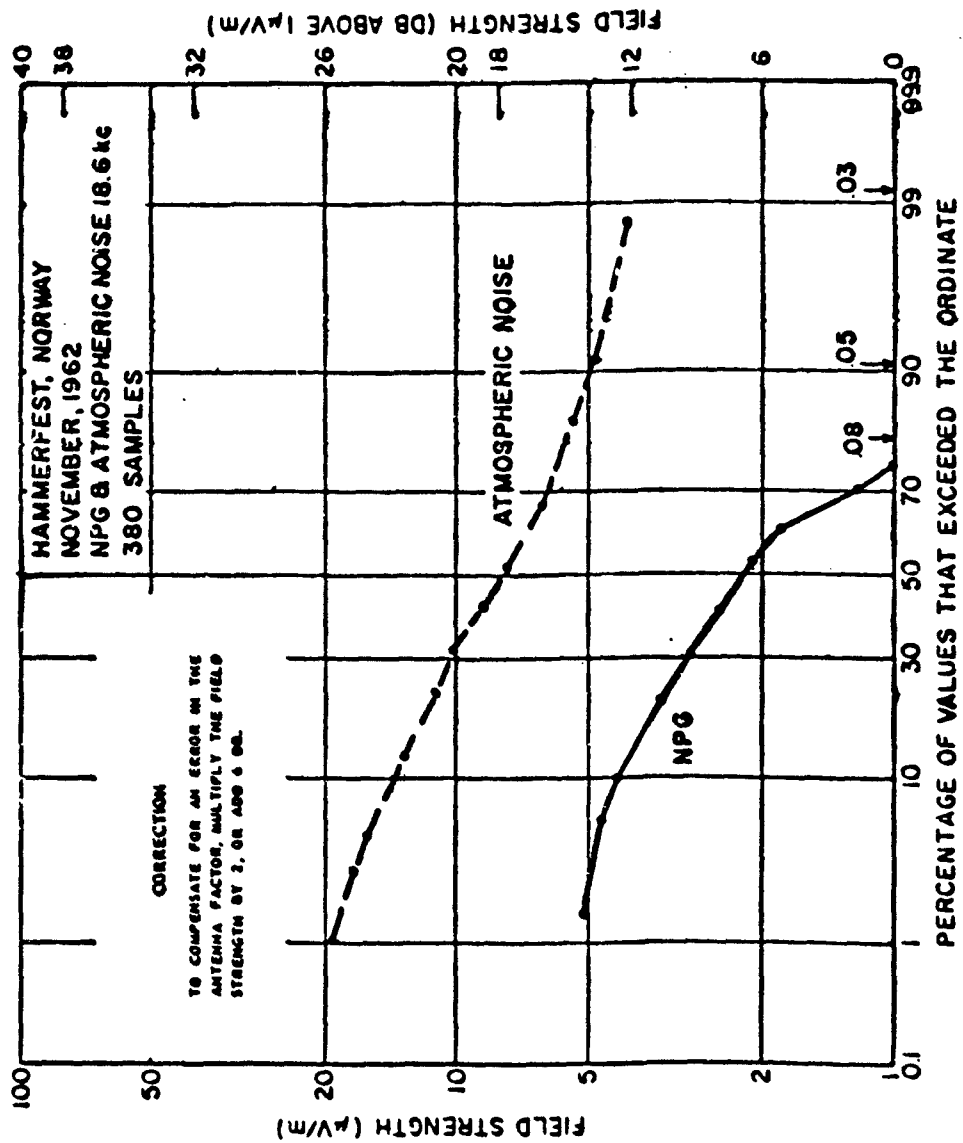


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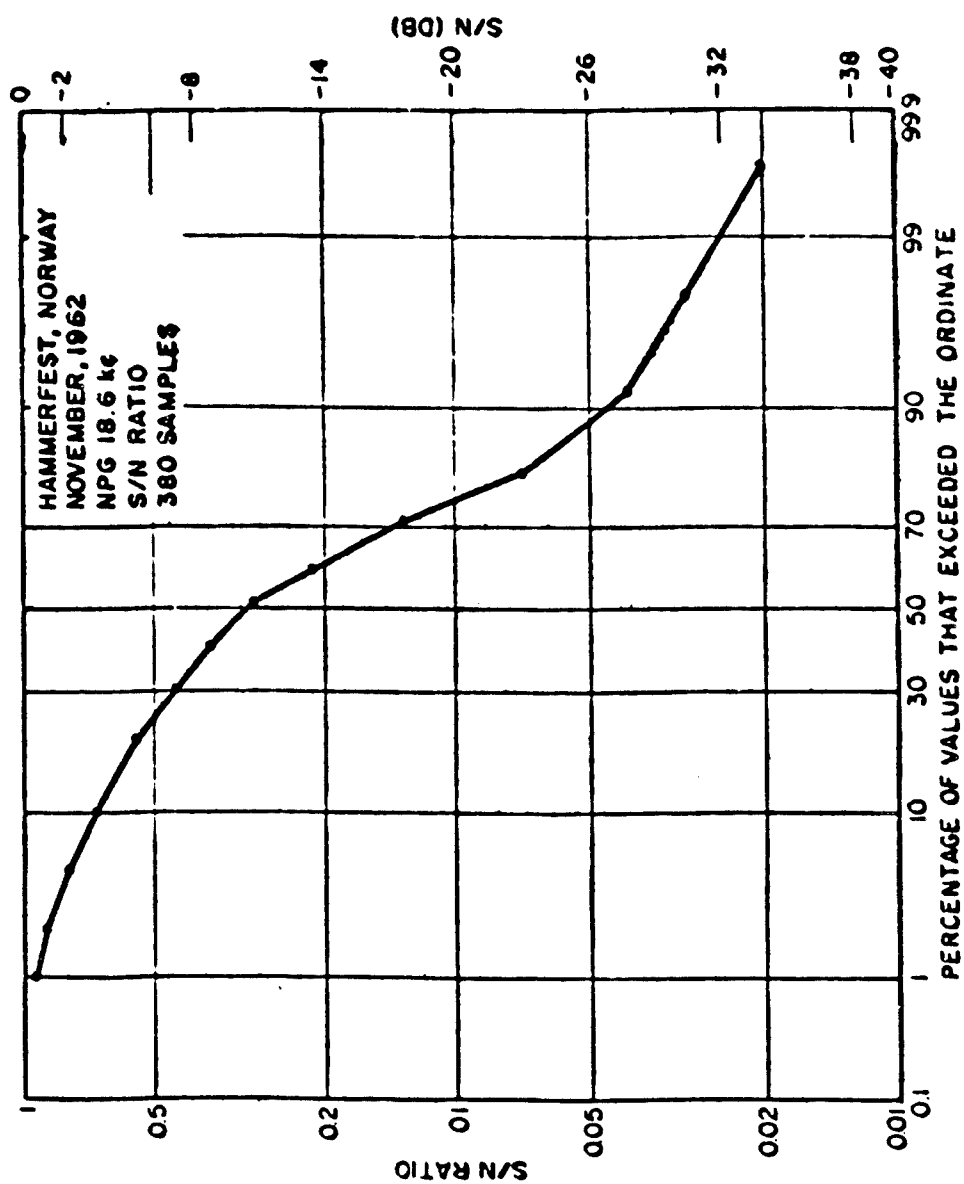


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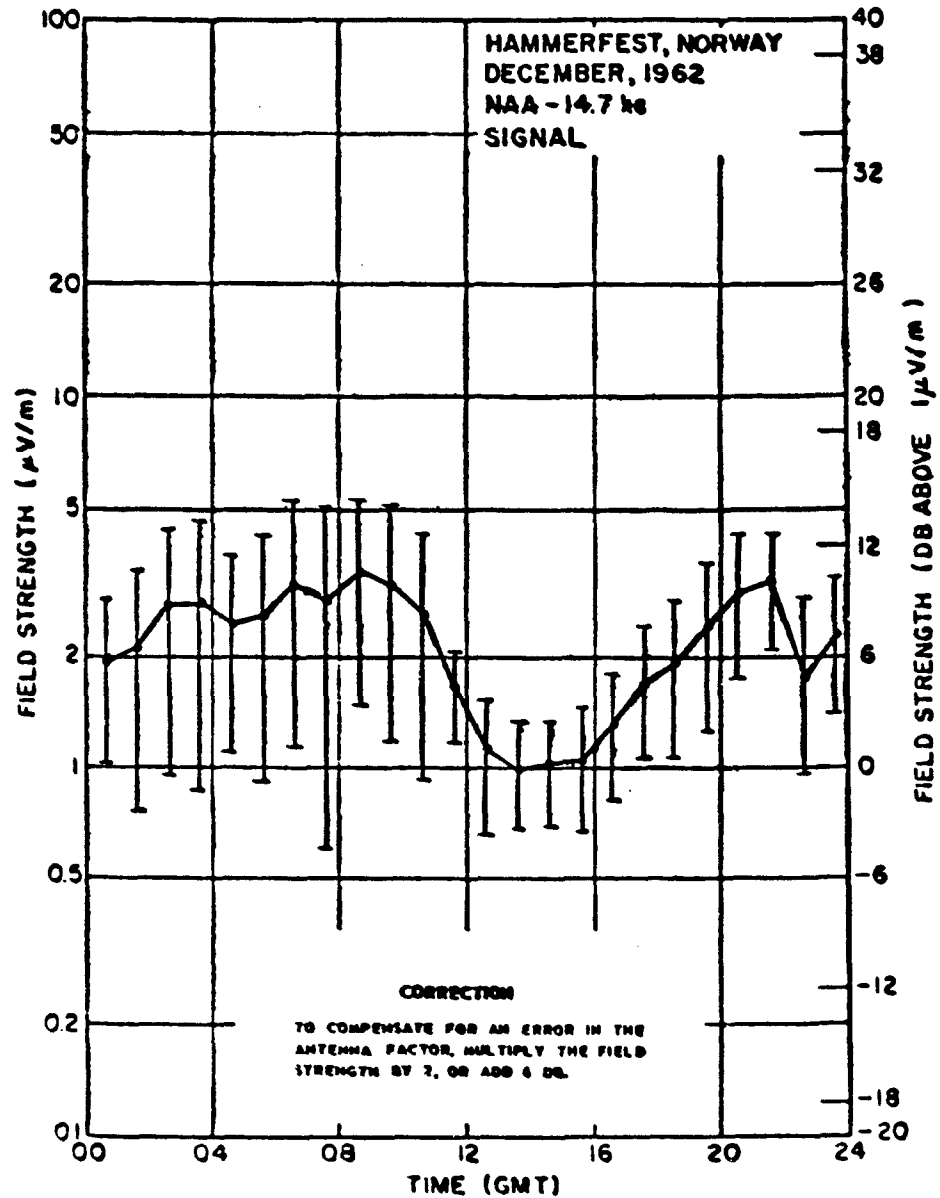


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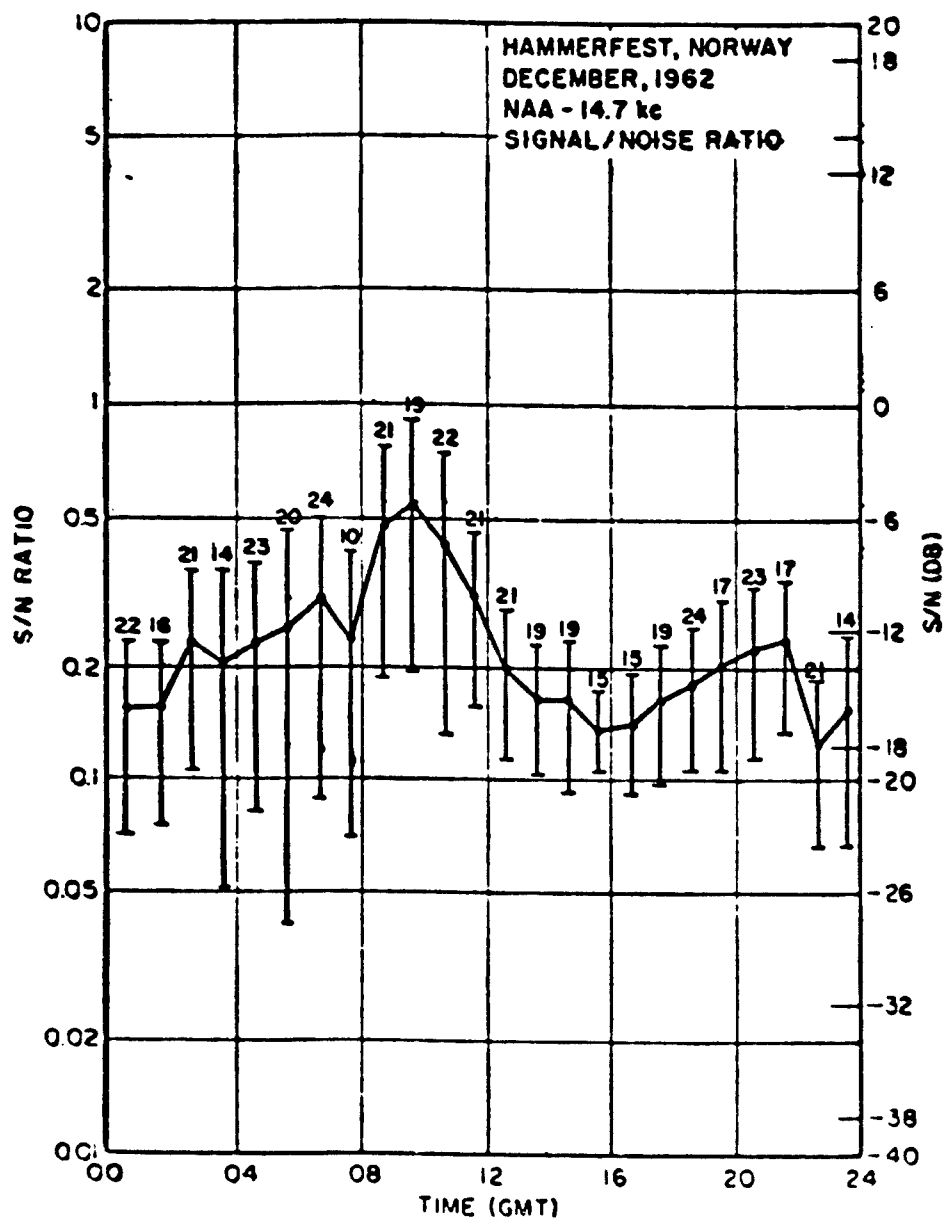


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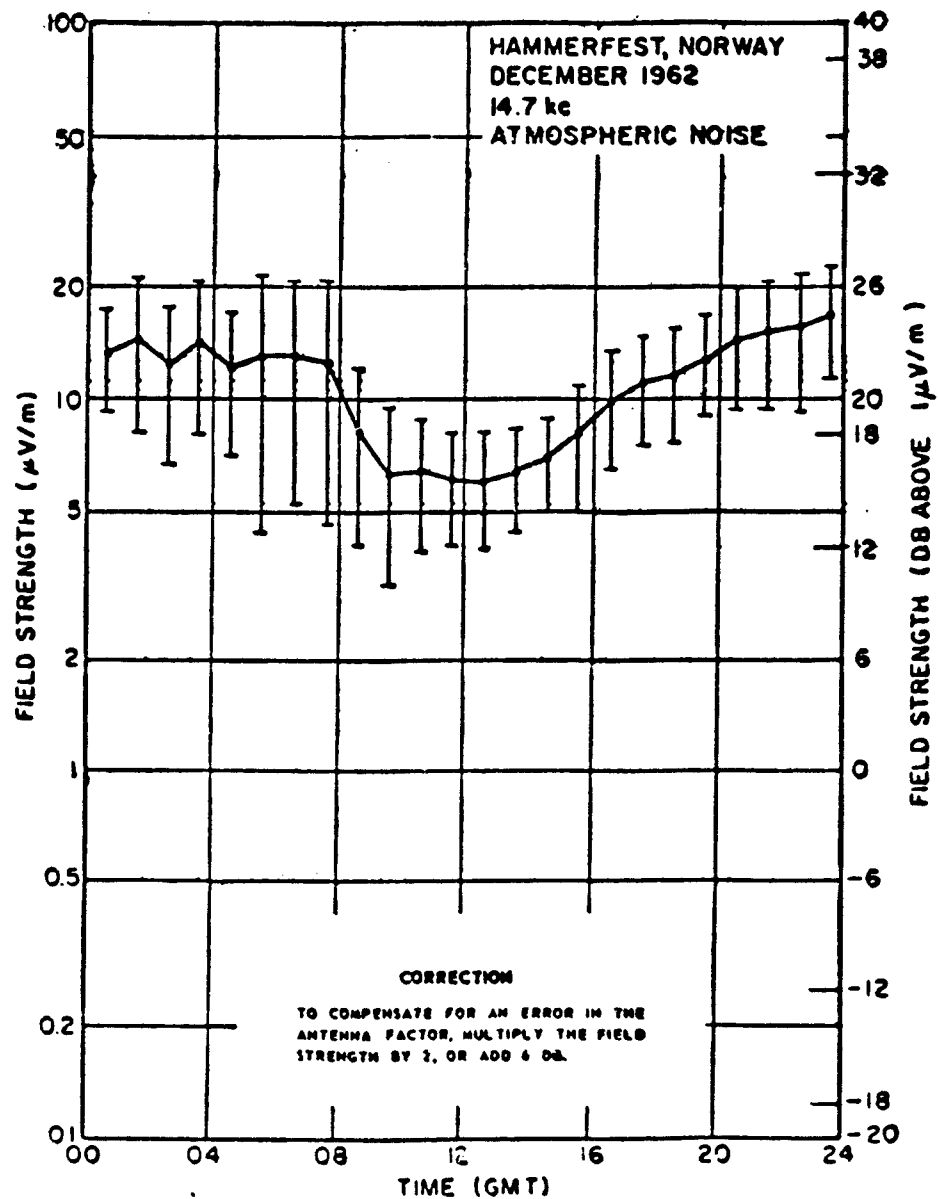


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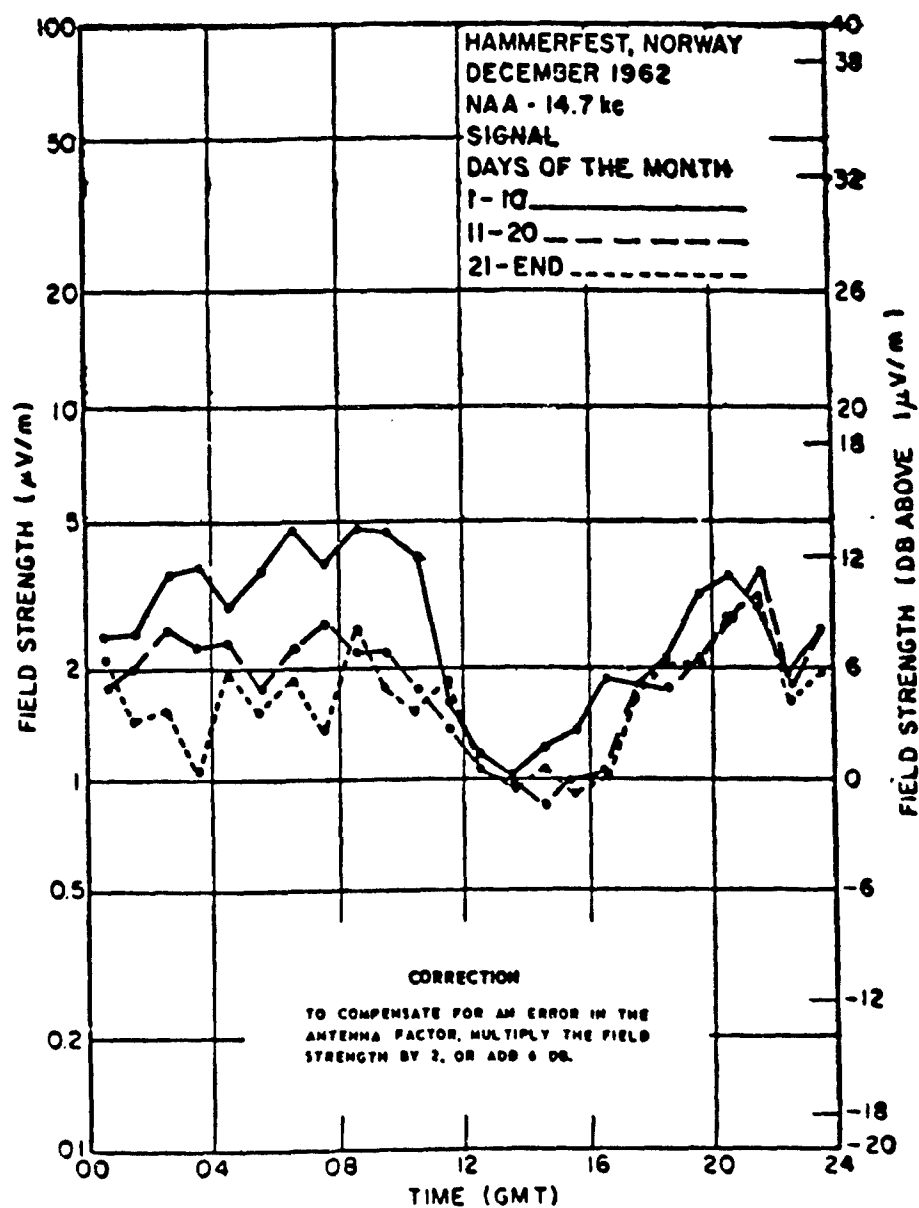


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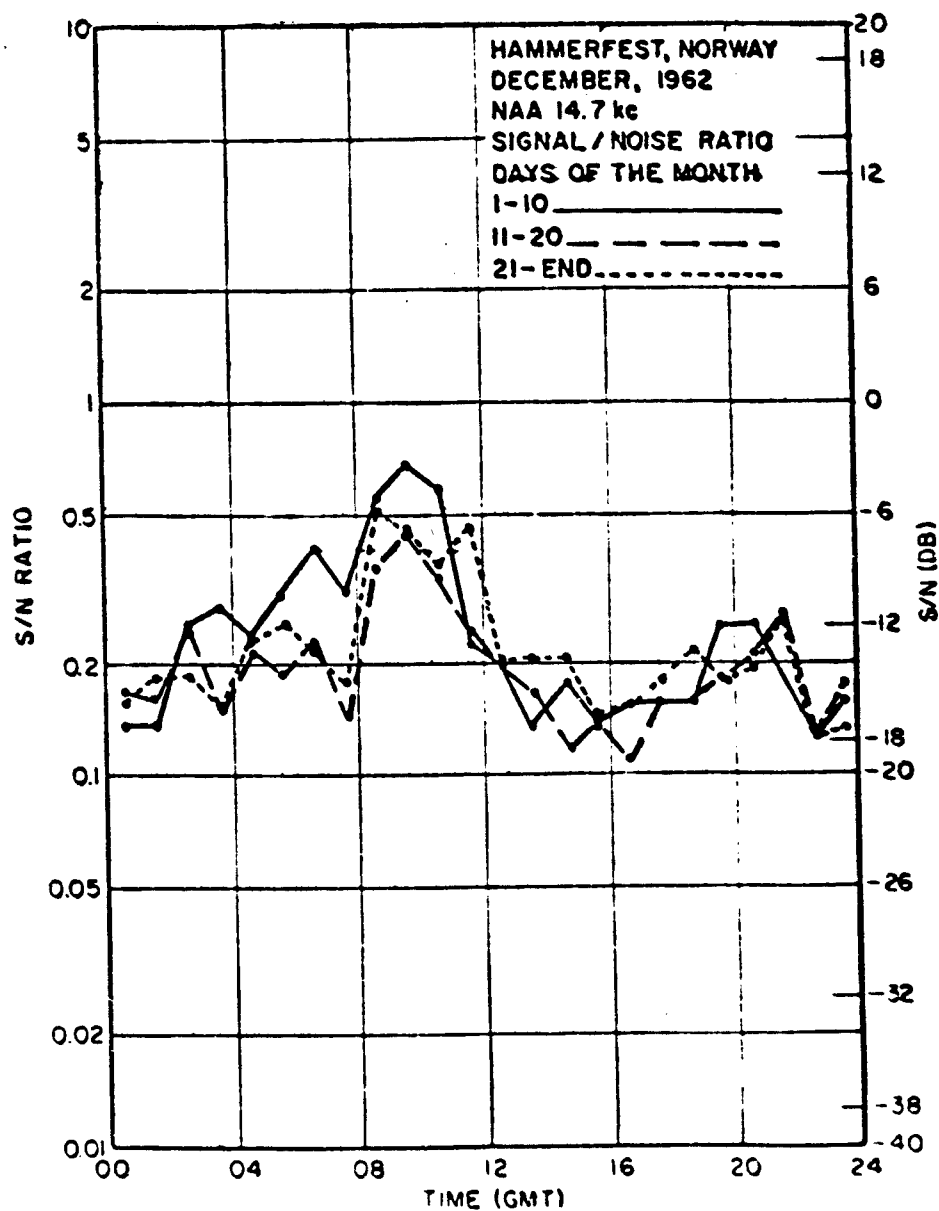


Figure 112

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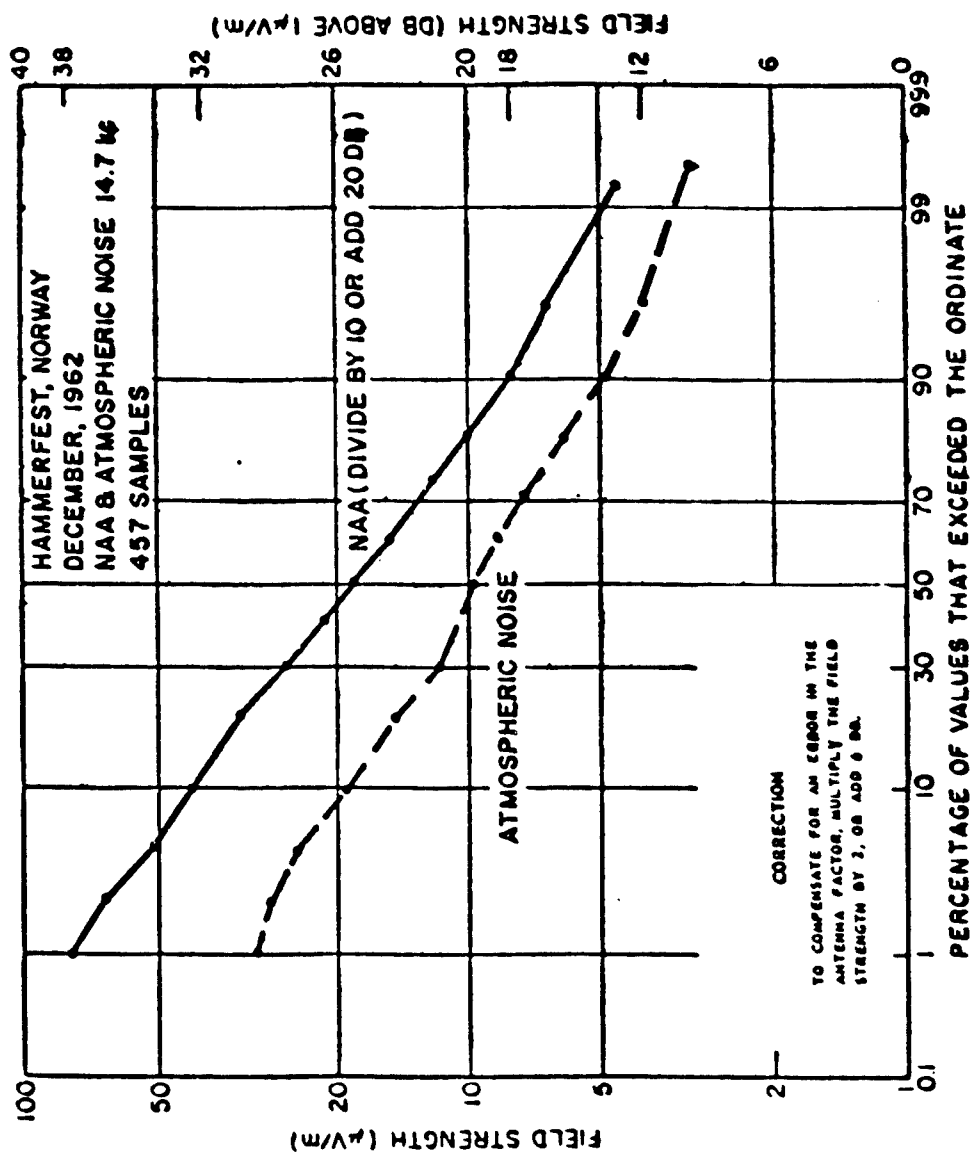


Figure 113

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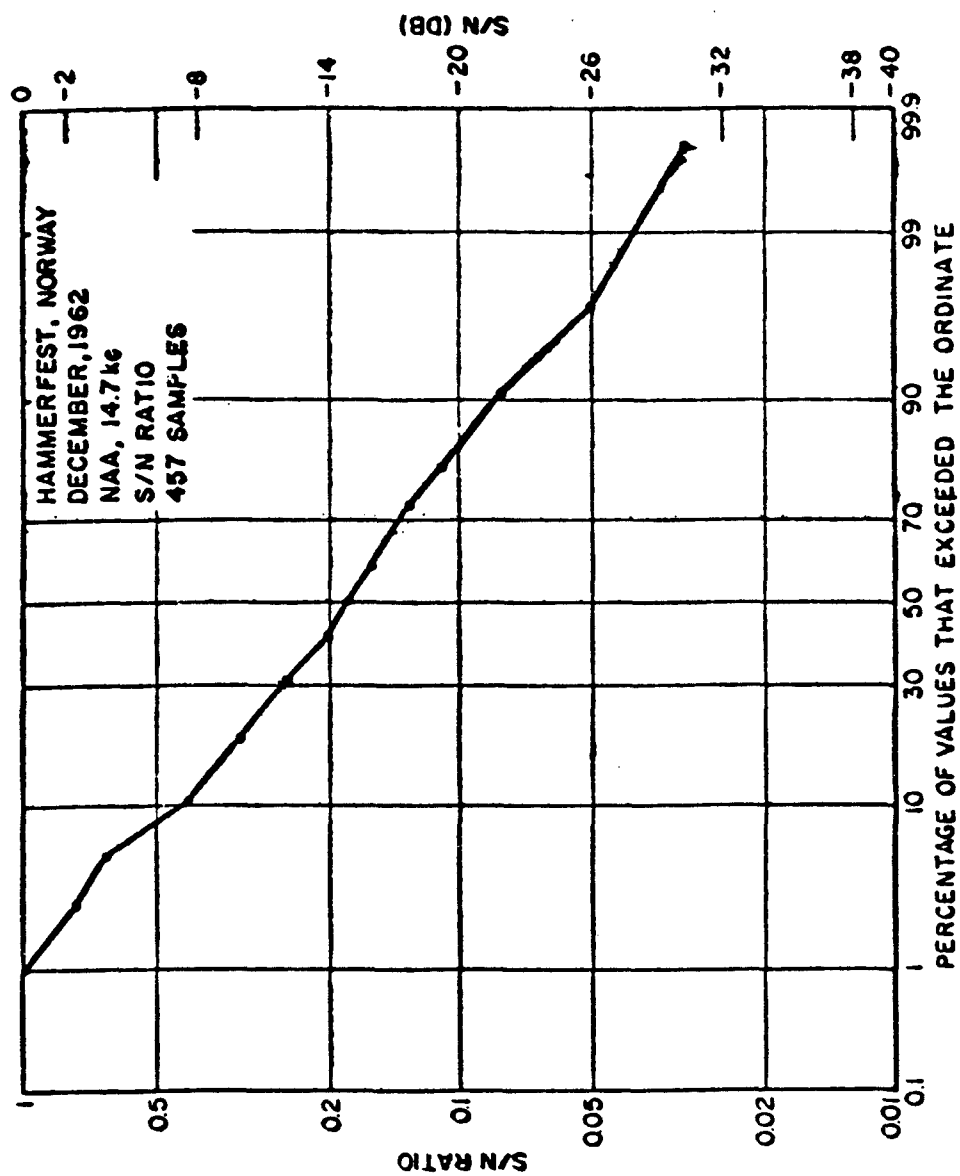


Figure 114

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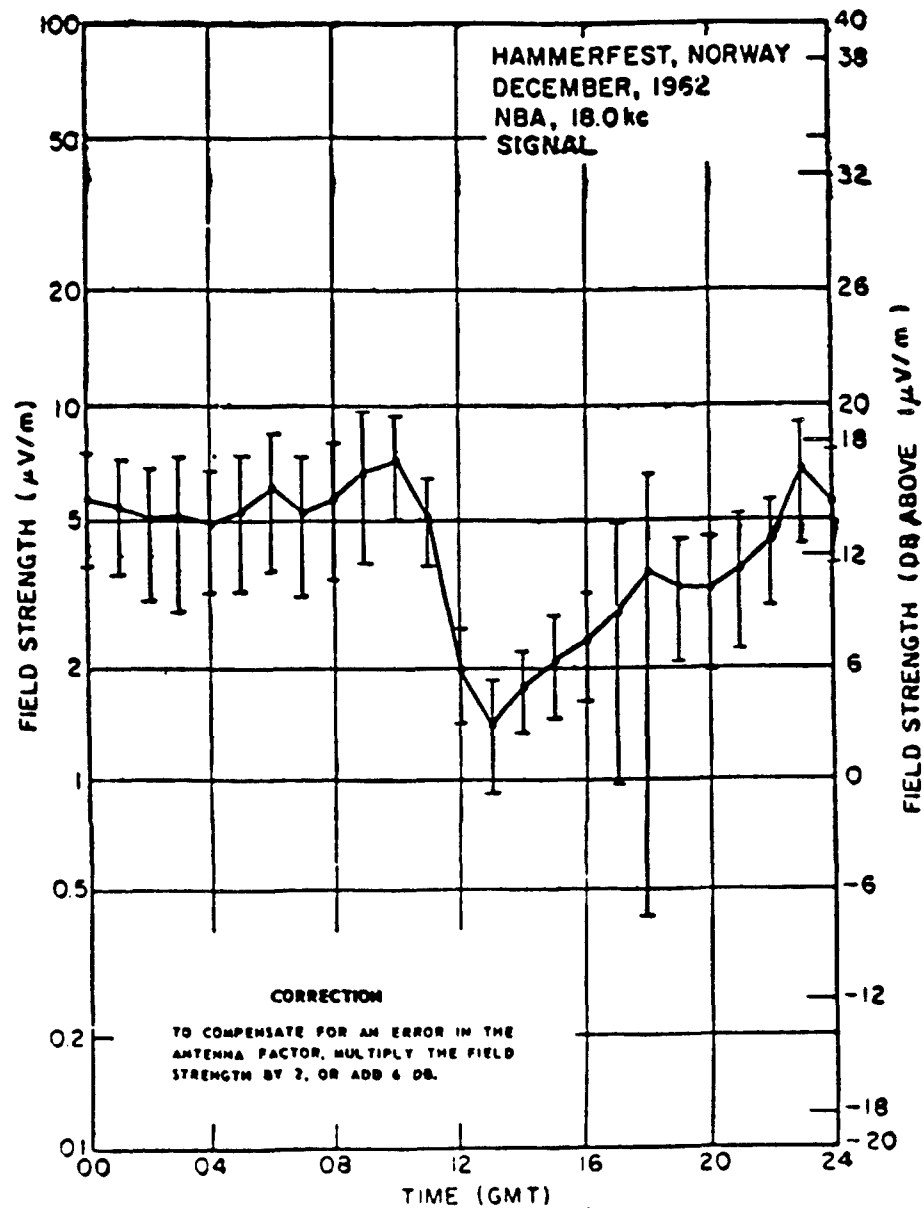


Figure 115

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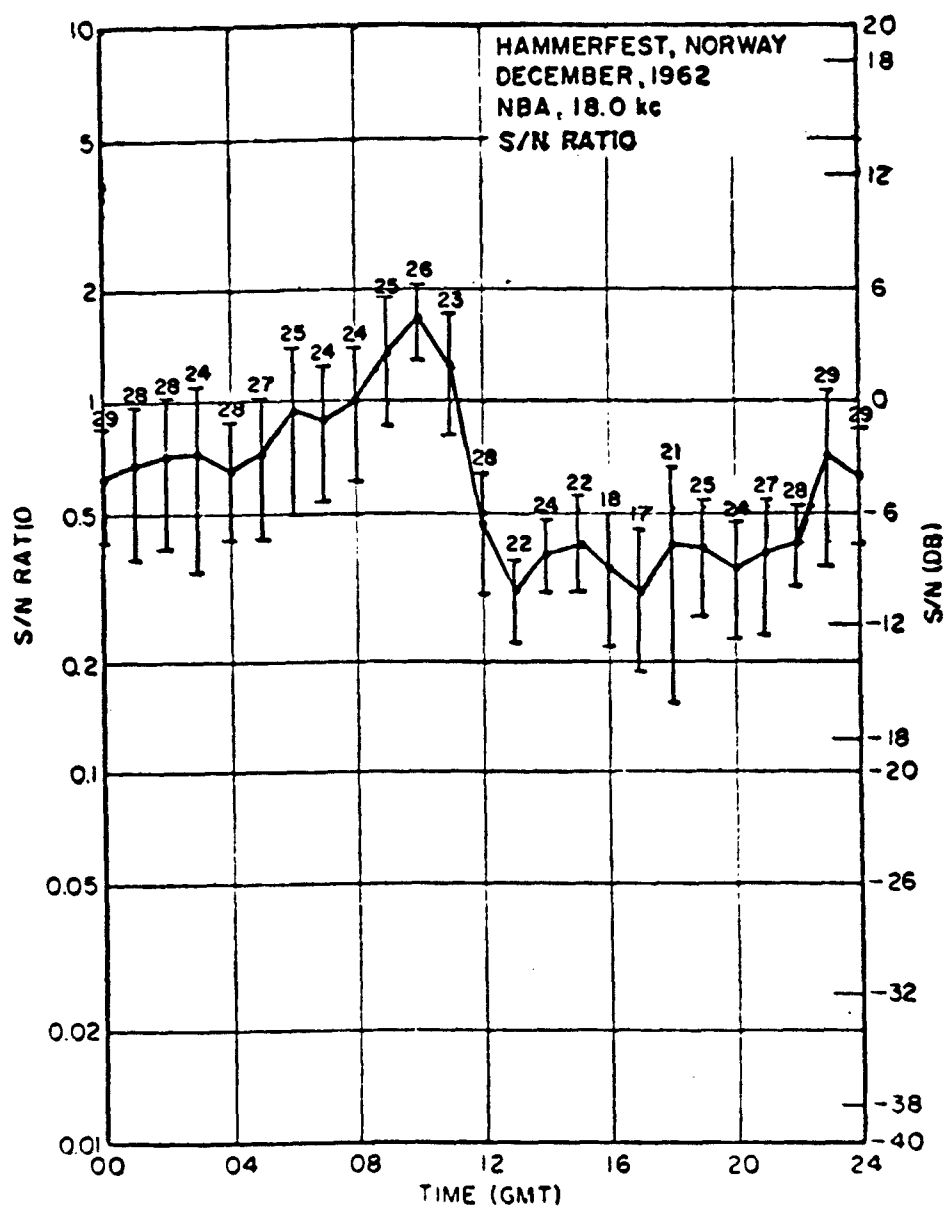


Figure 116

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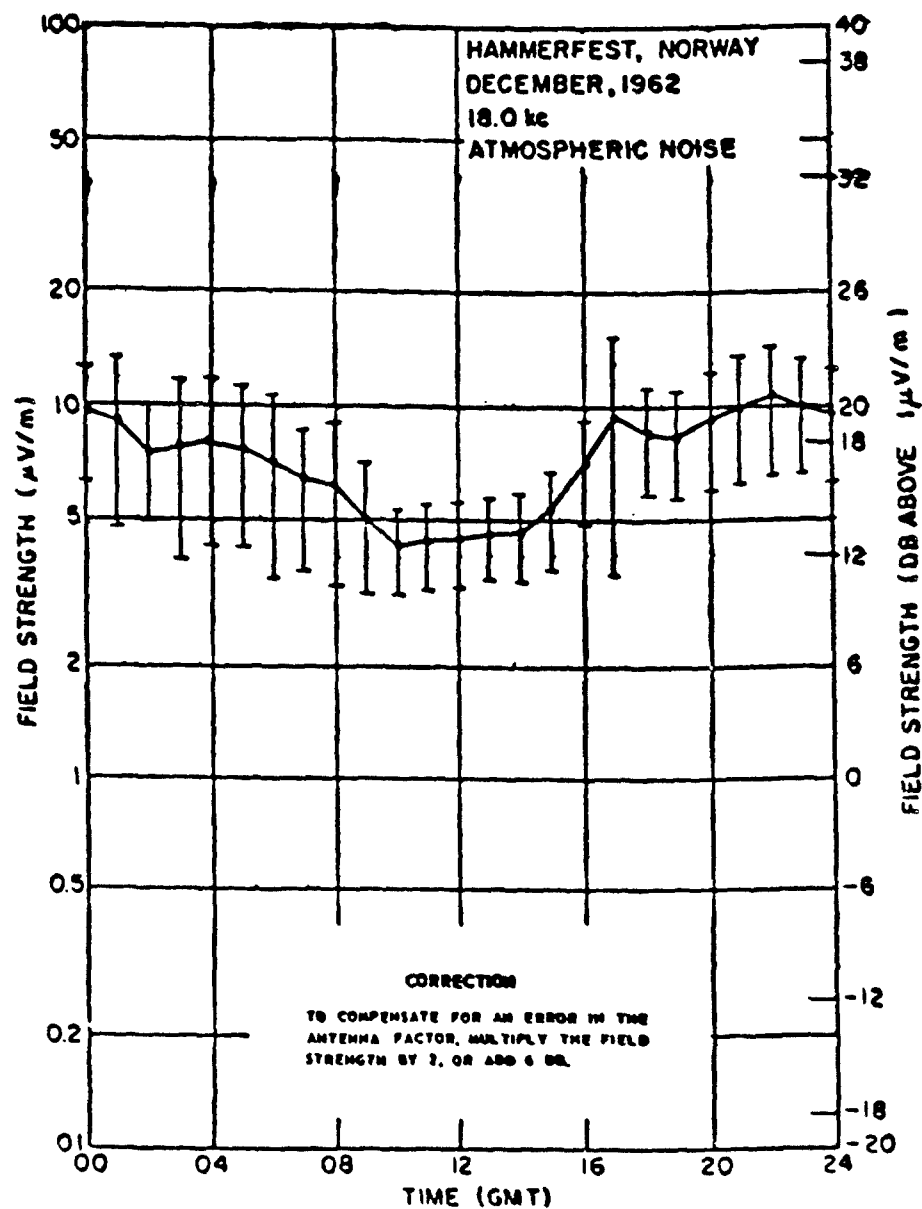


Figure 117

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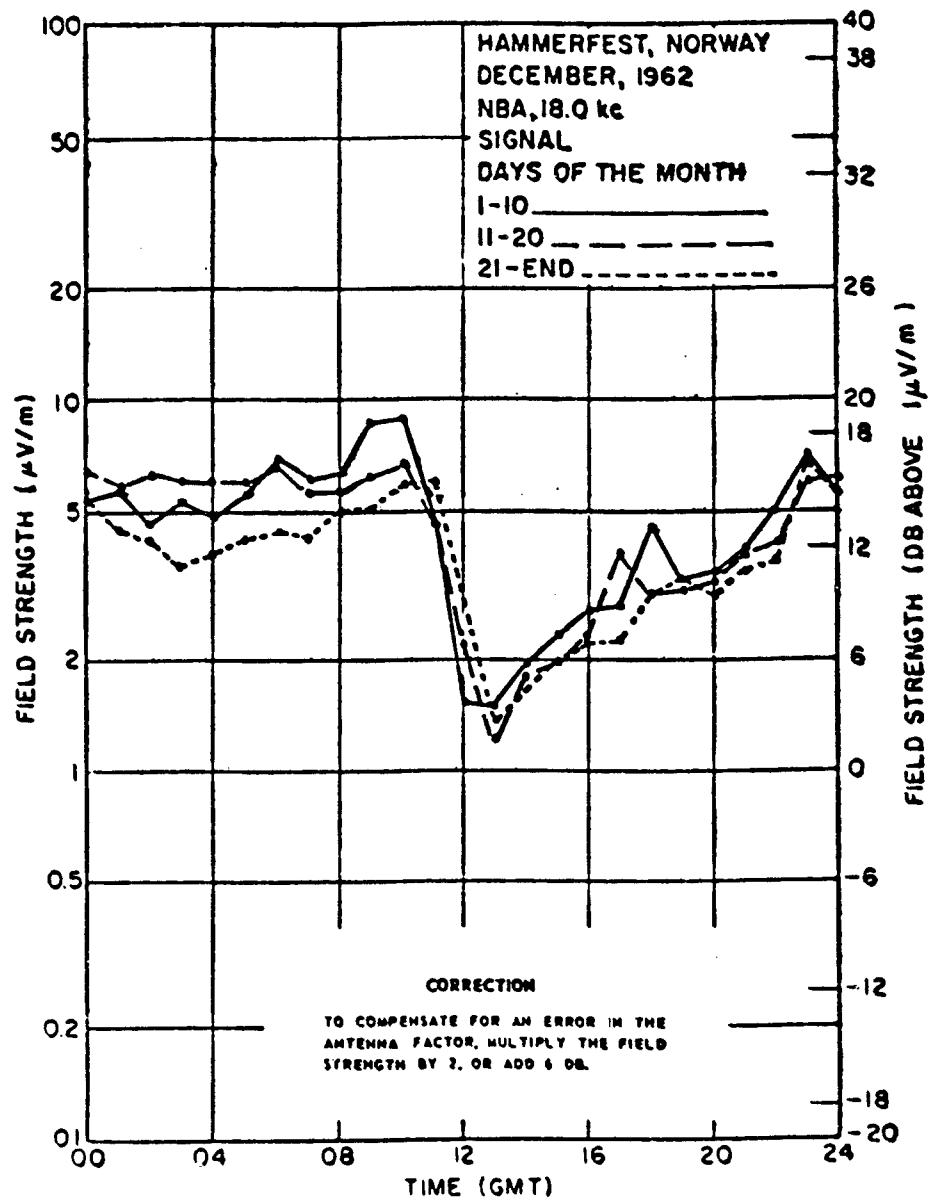


Figure 118

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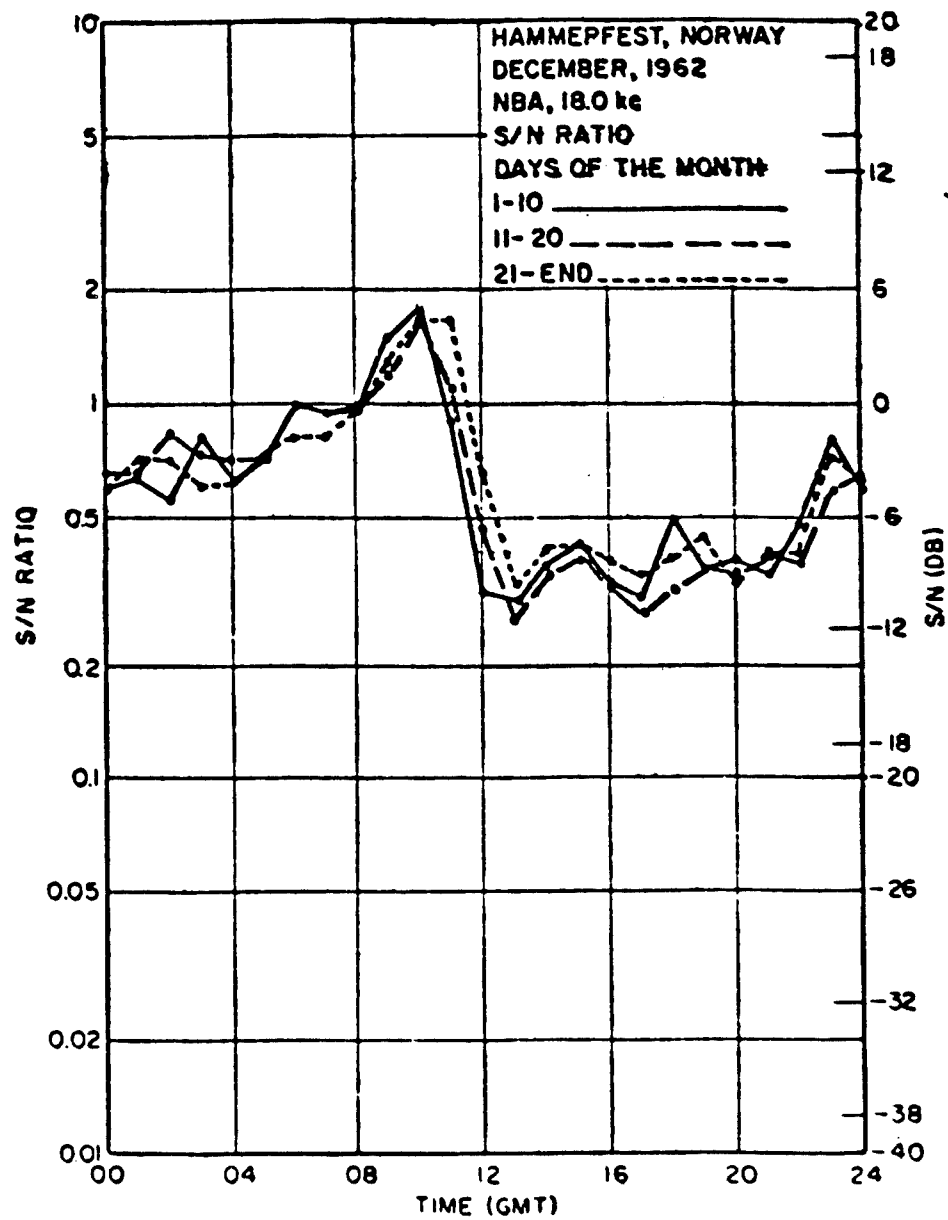


Figure 119

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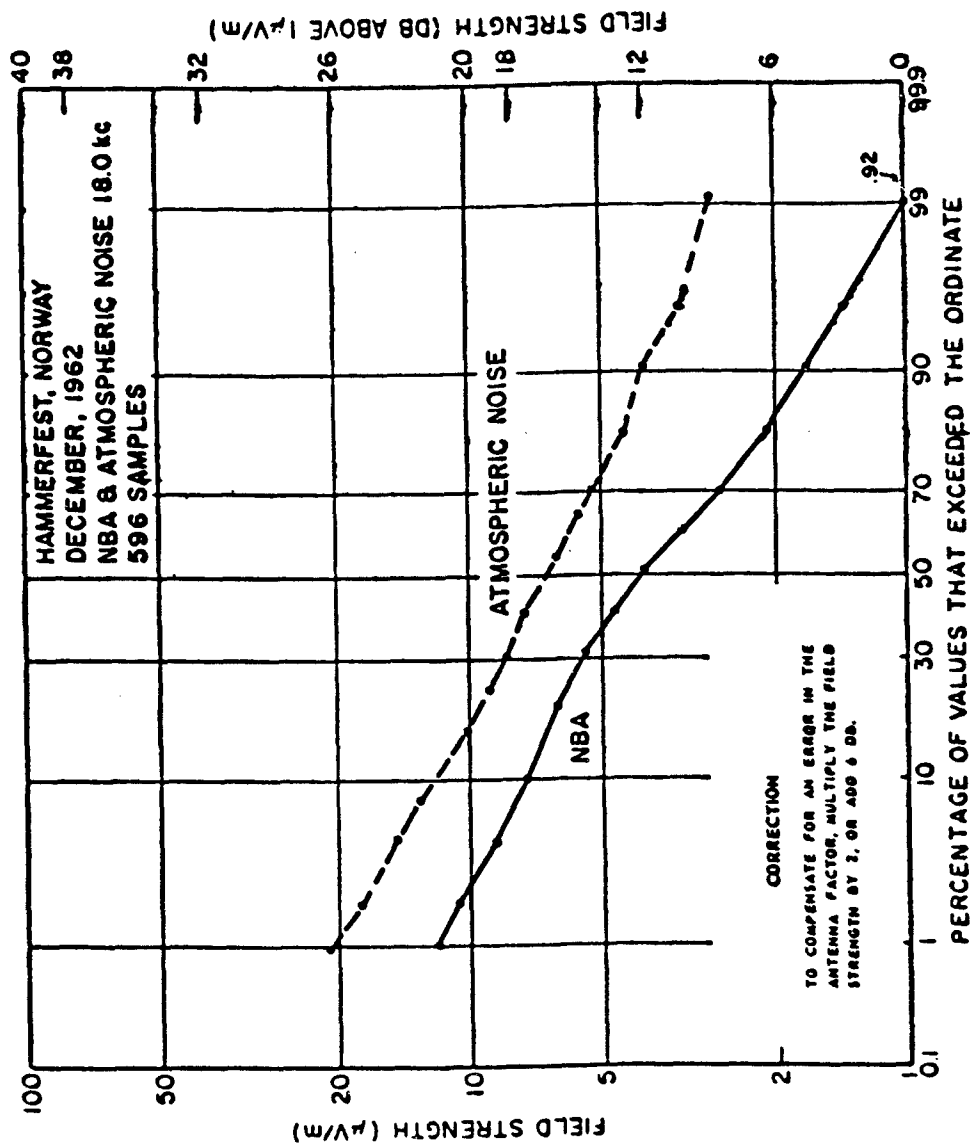


Figure 120

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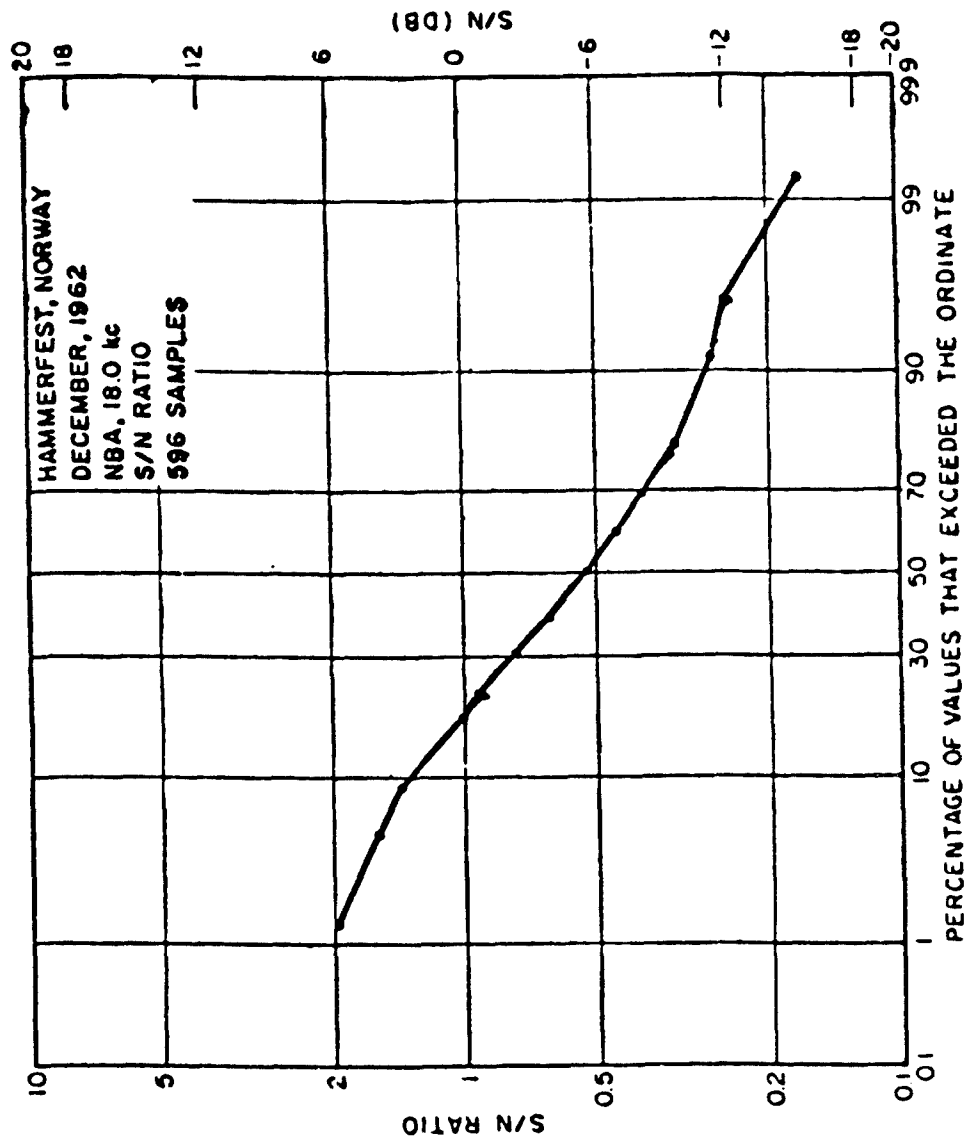


Figure 121

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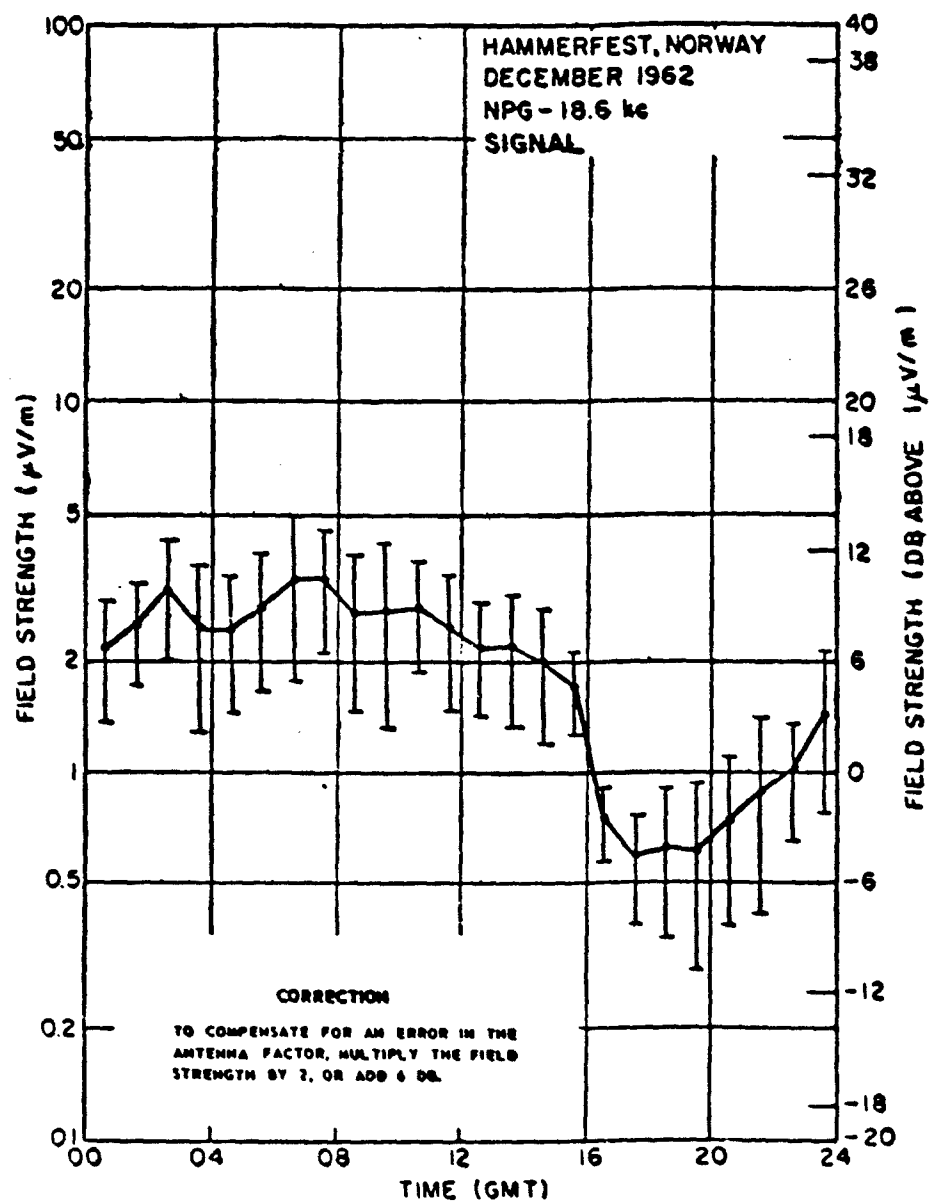


Figure 122

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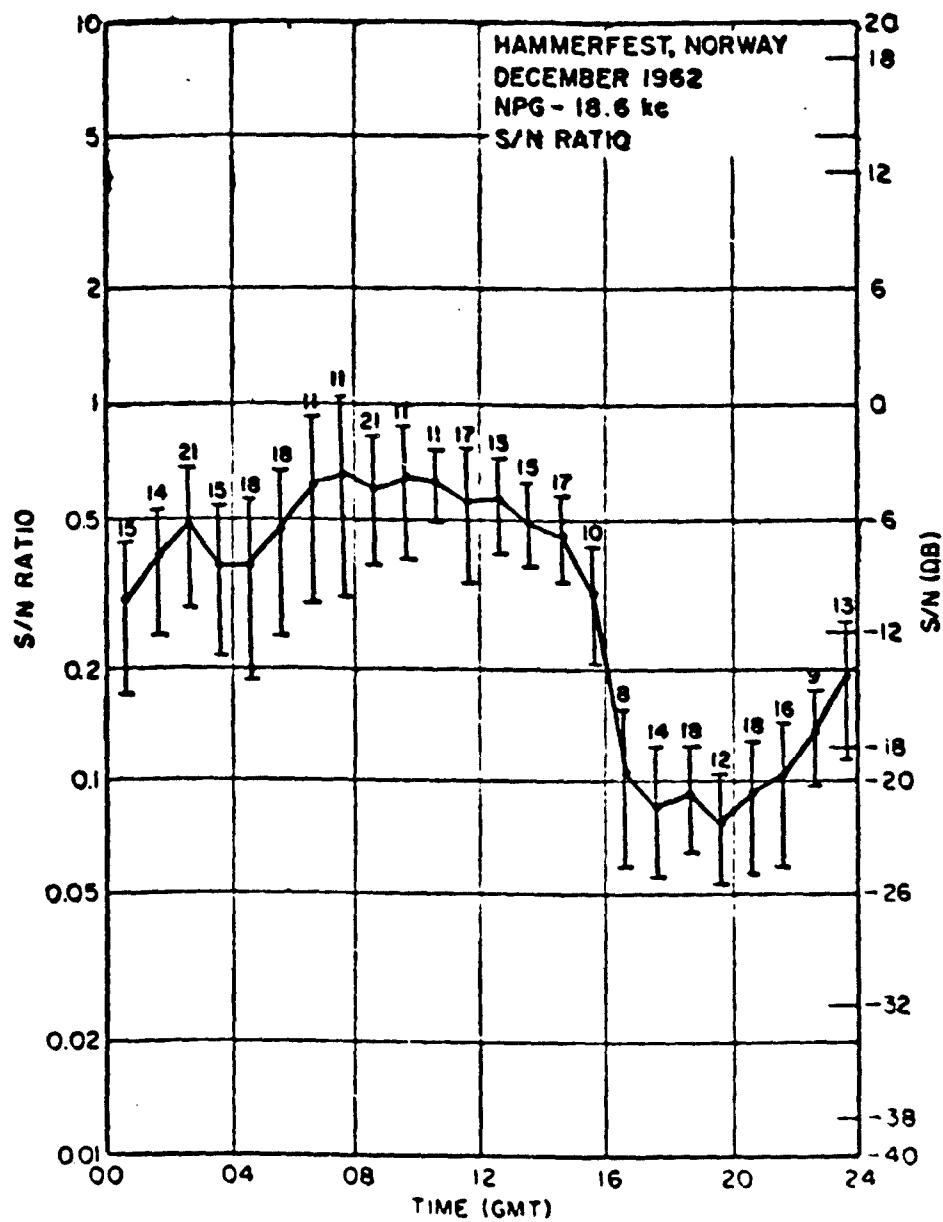


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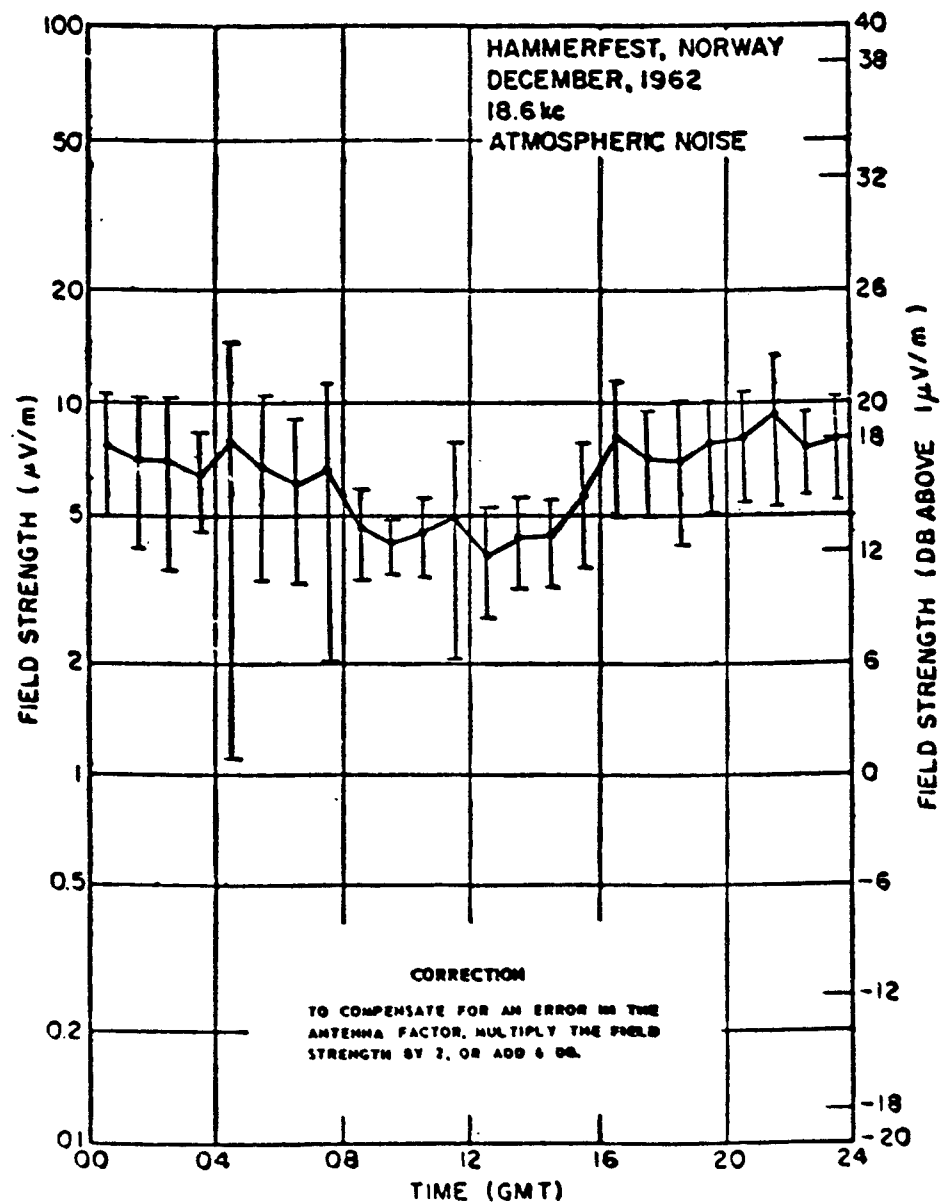


Figure 124

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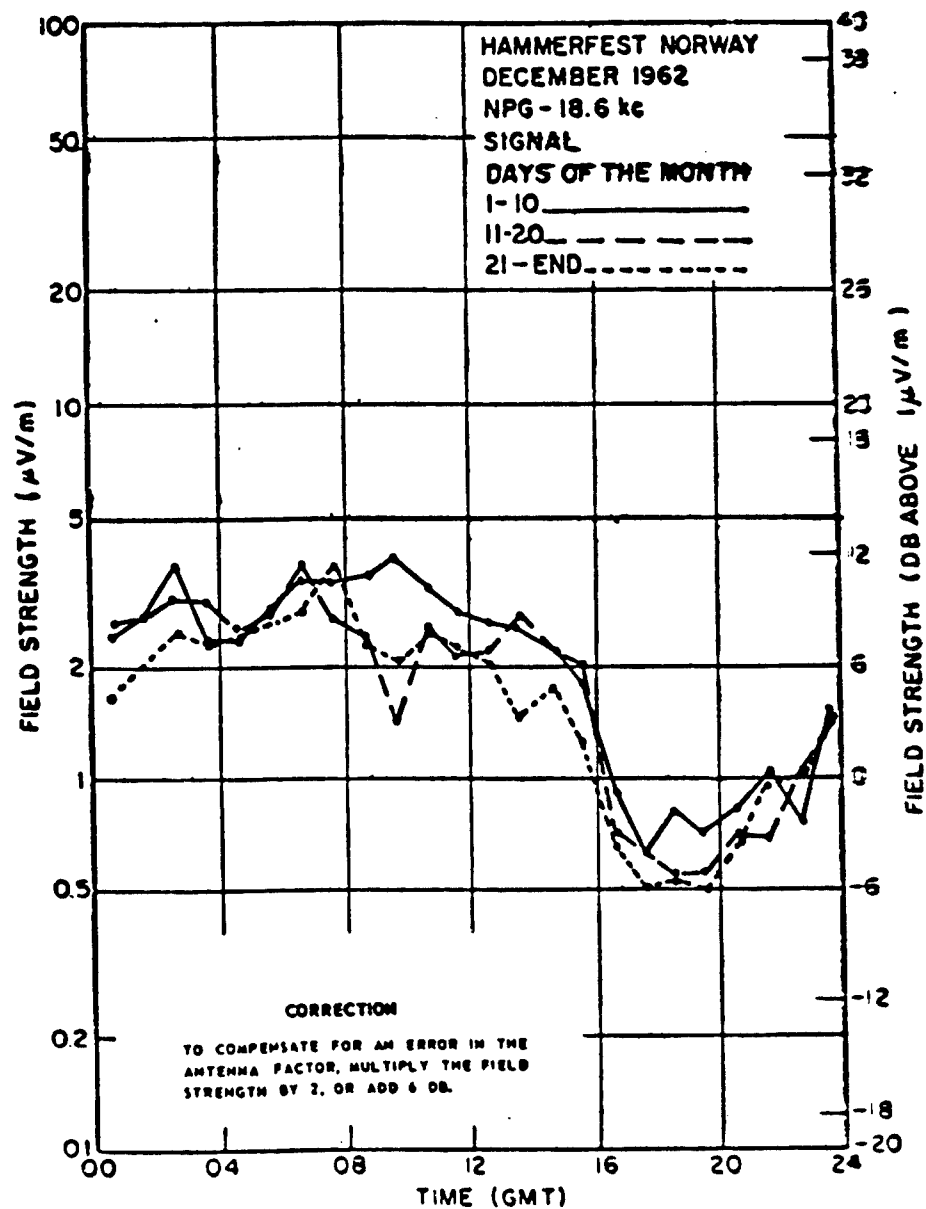


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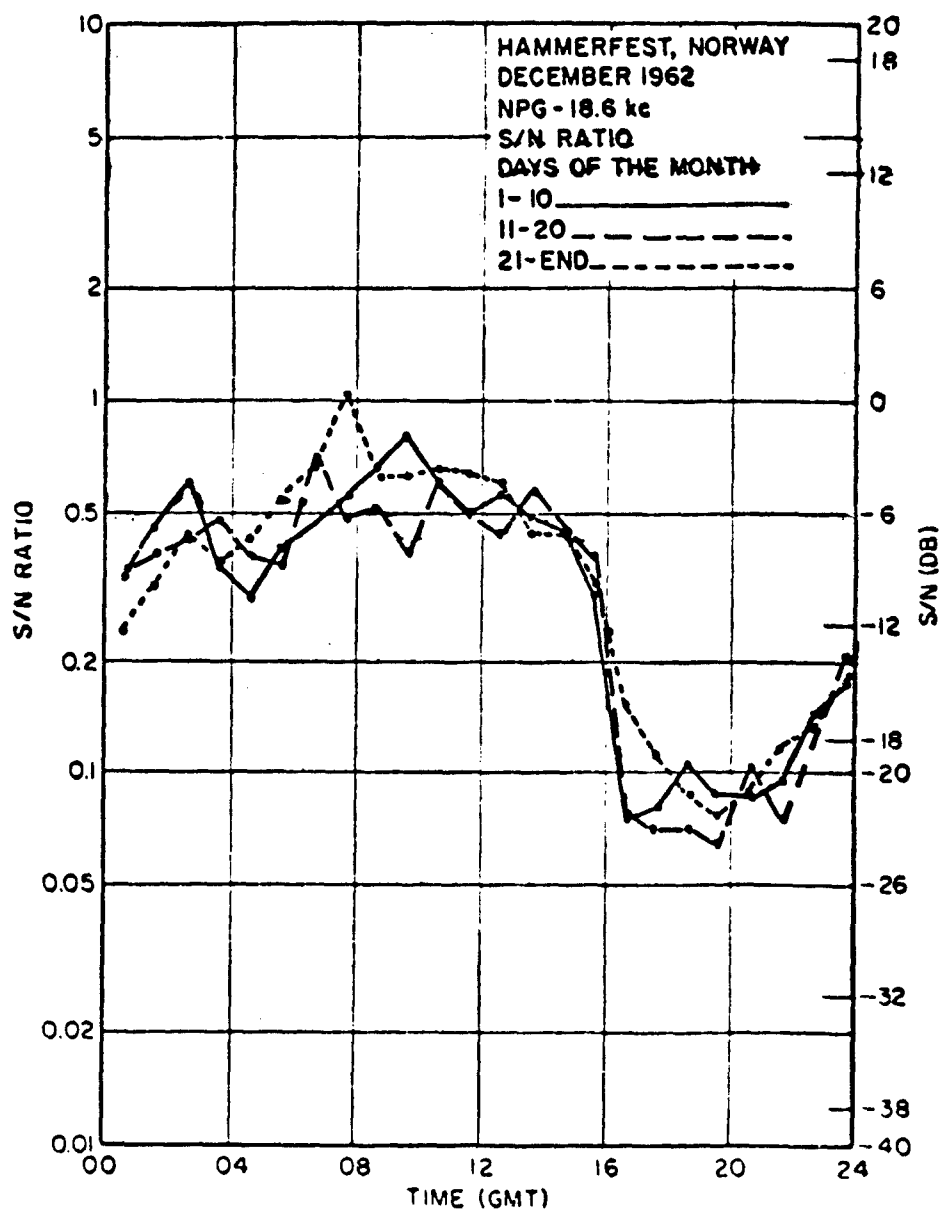


Figure 126

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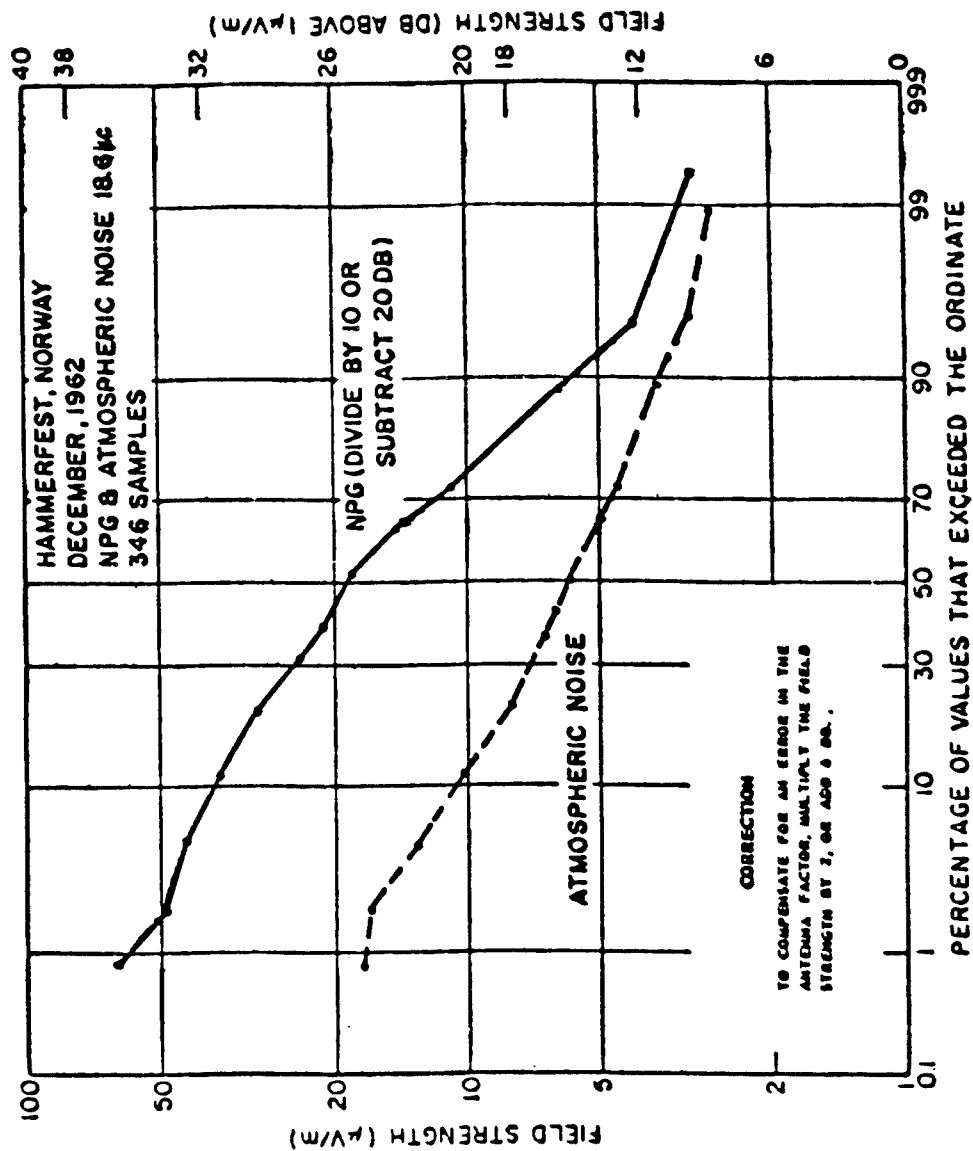


Figure 127

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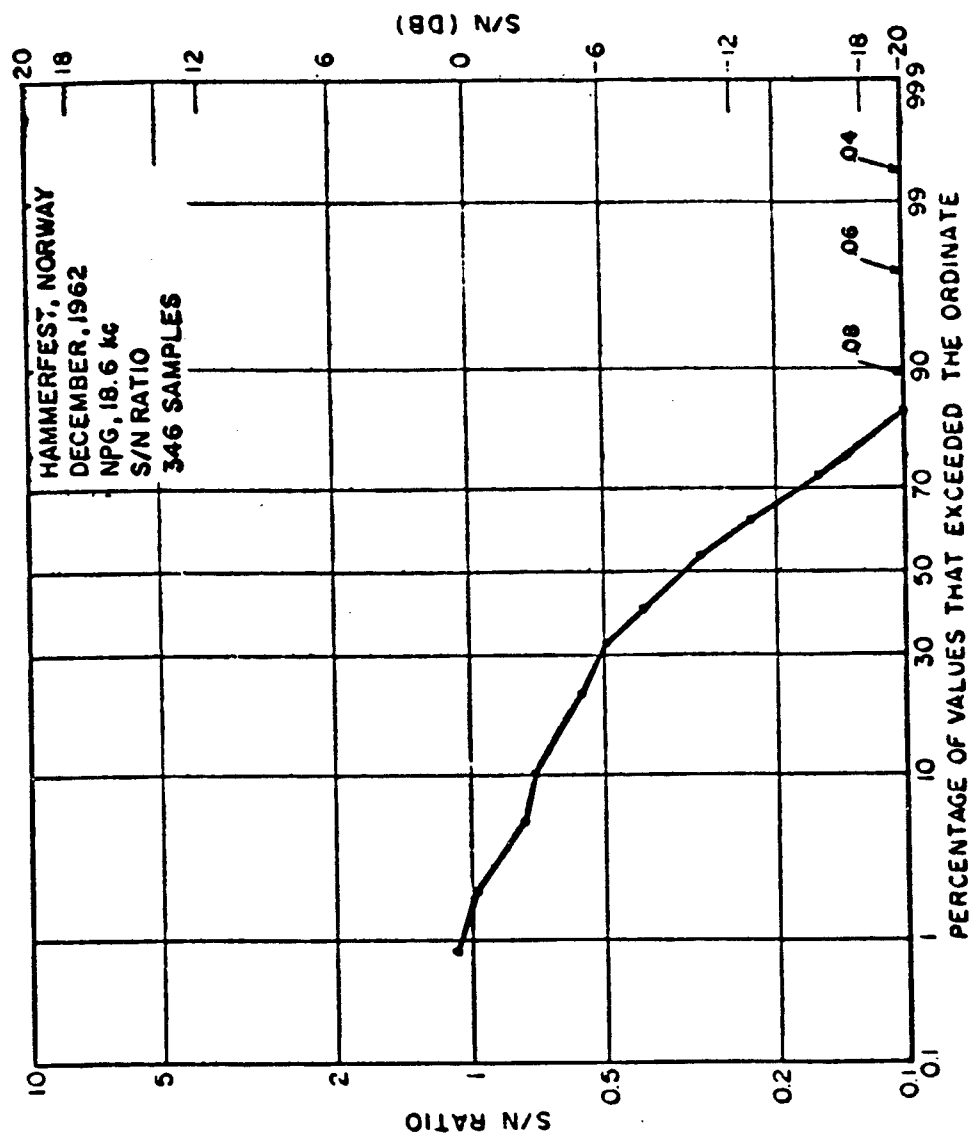


Figure 128

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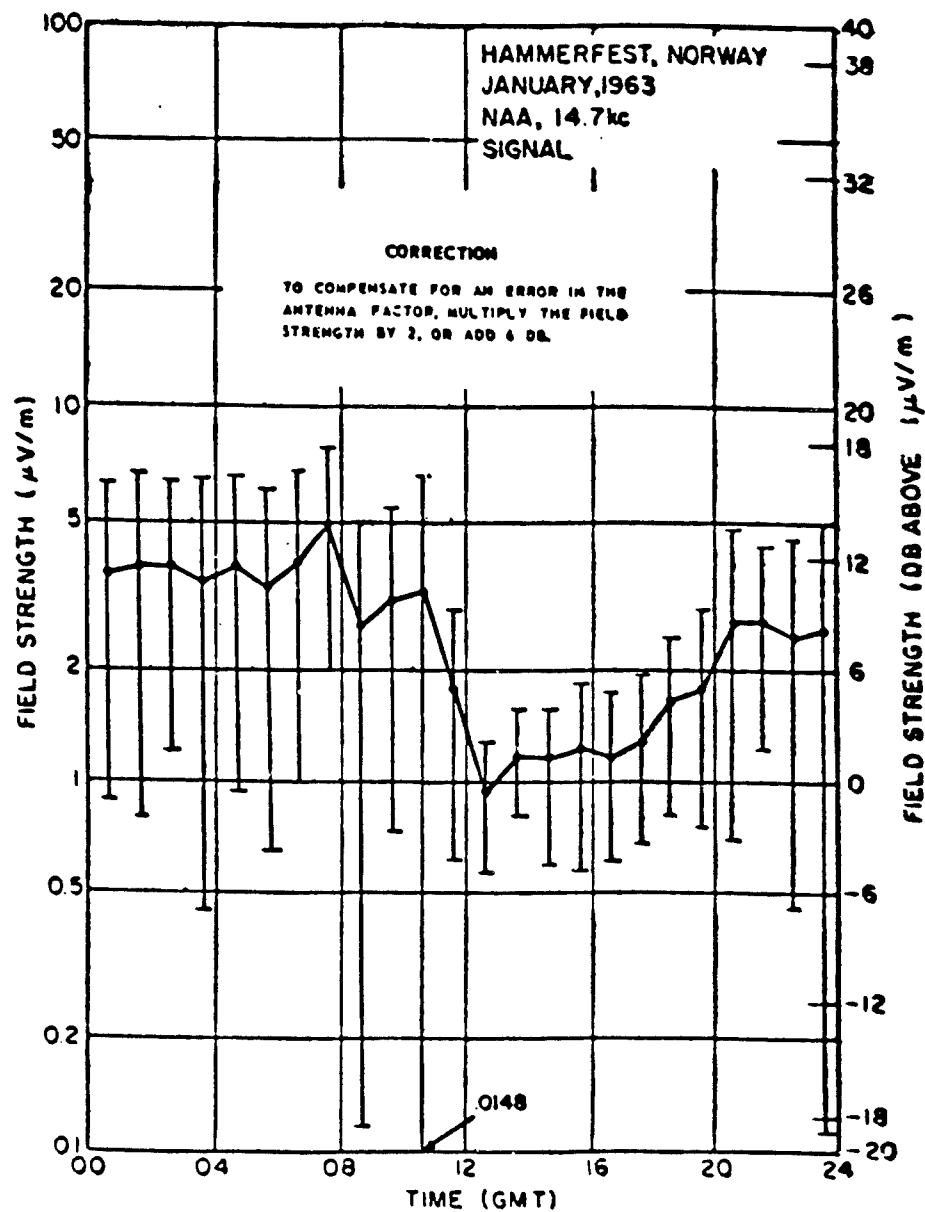


Figure 129

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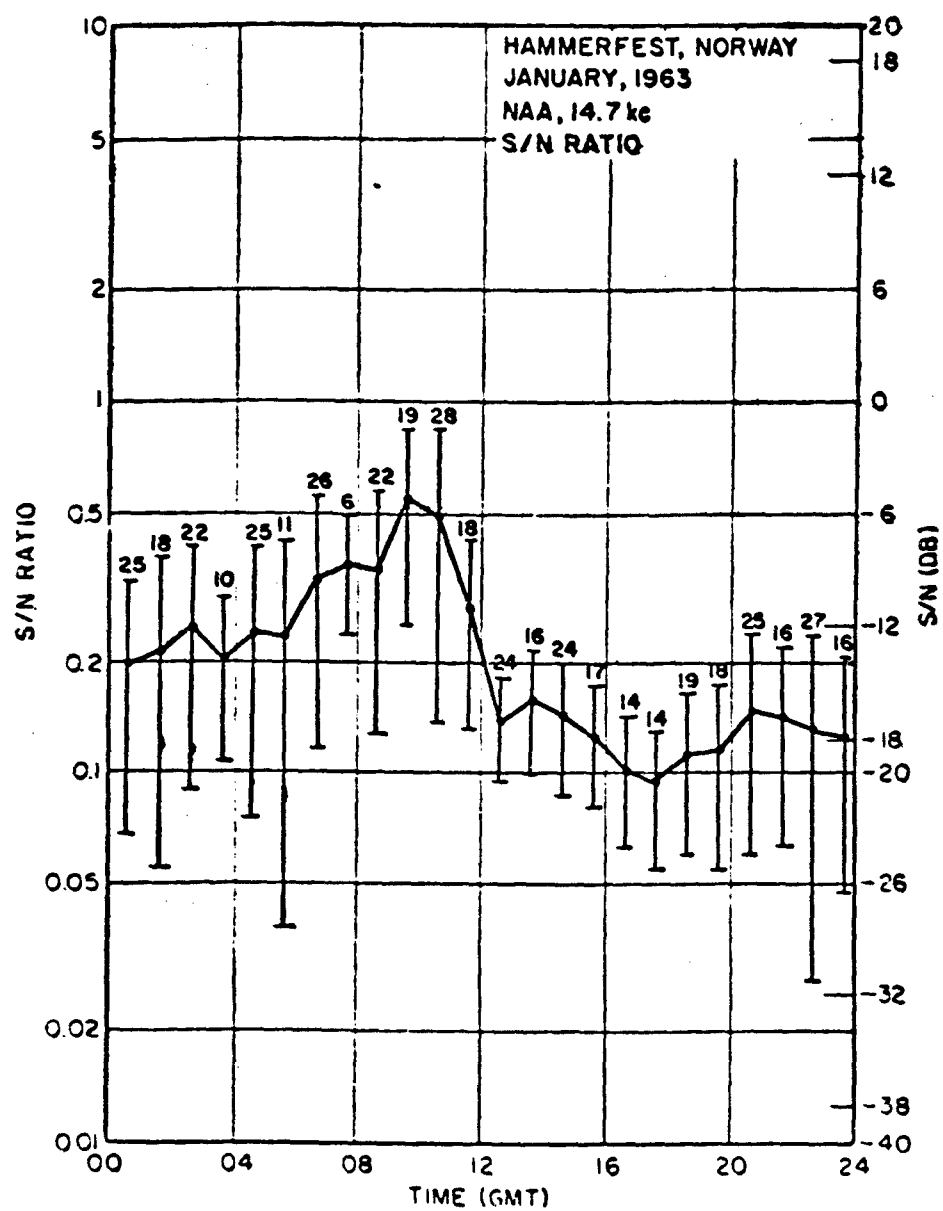


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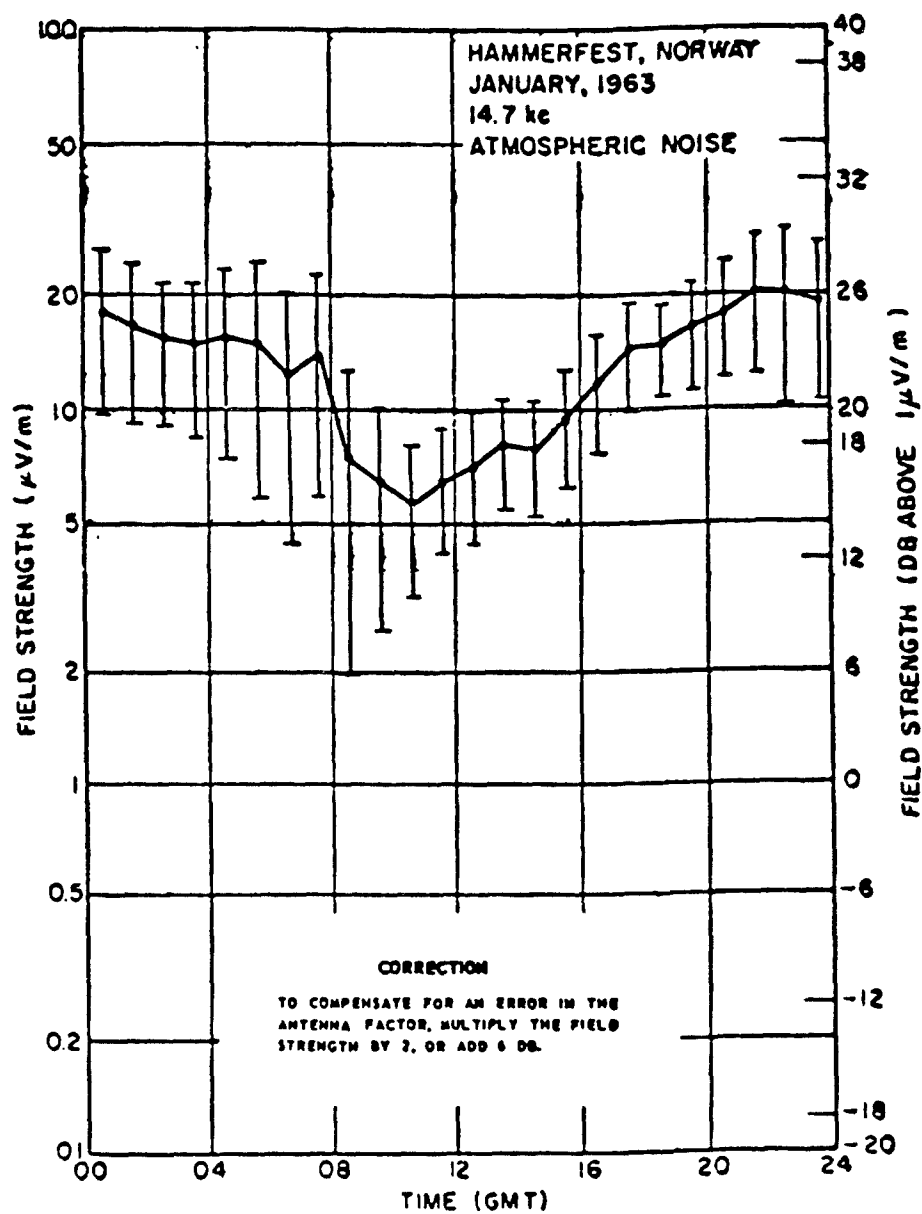


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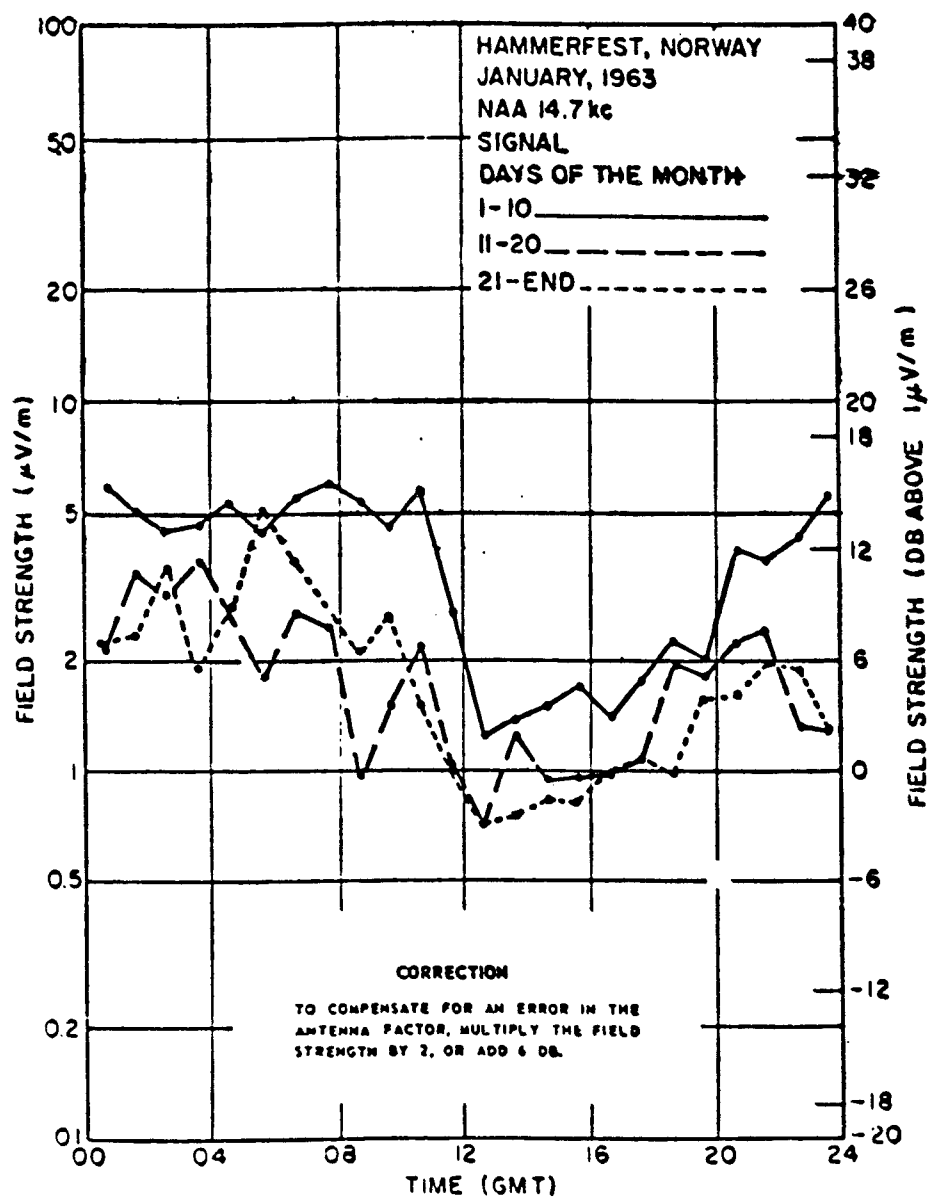


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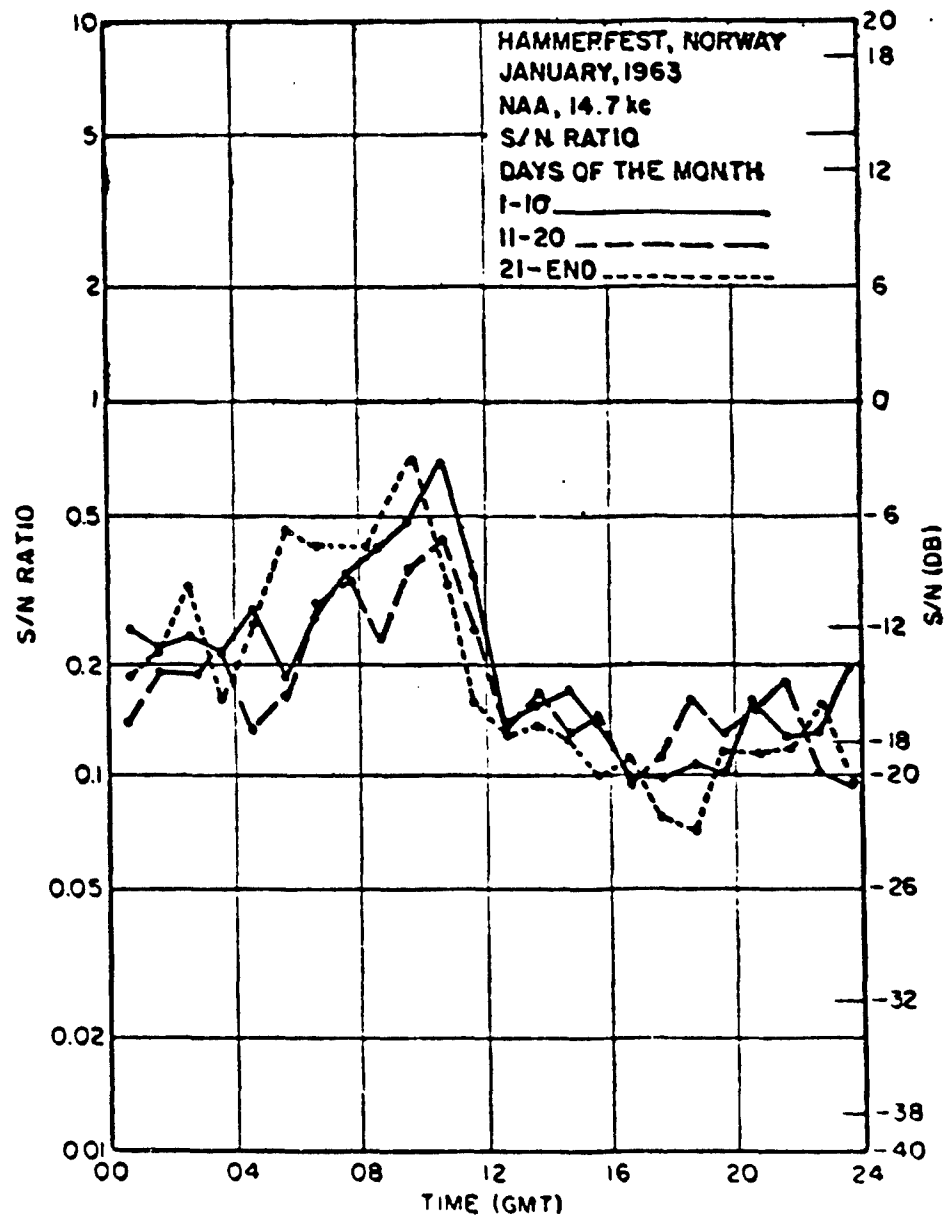


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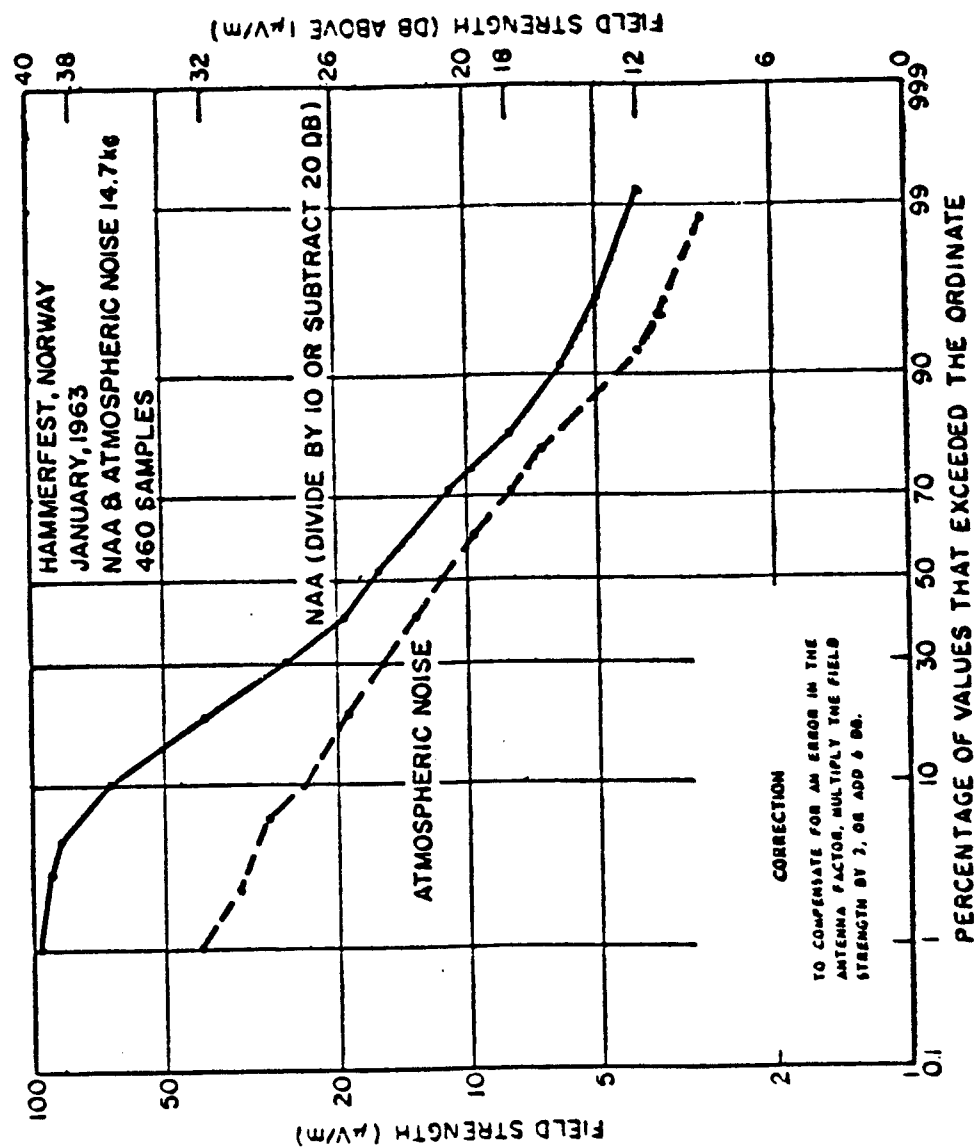


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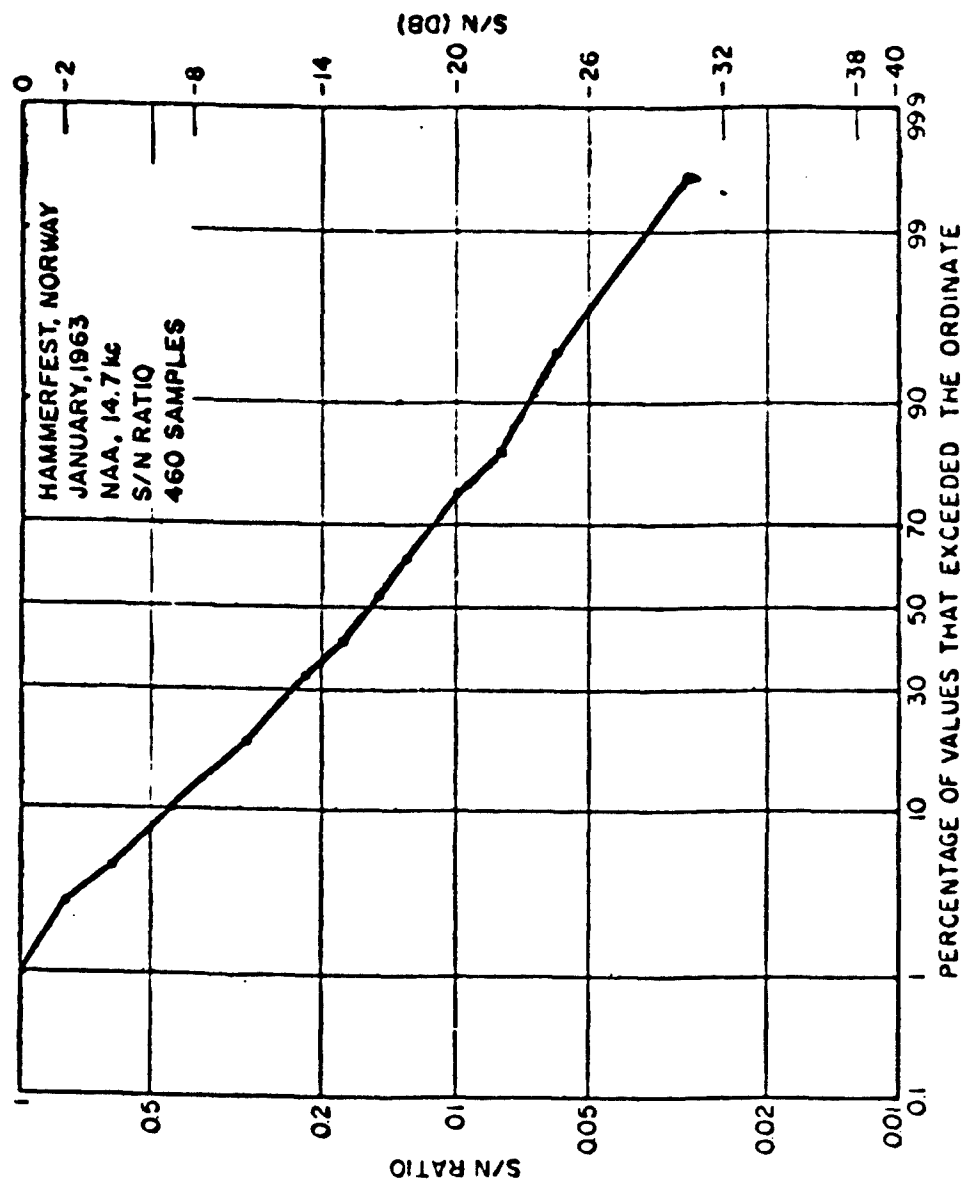


Figure 135

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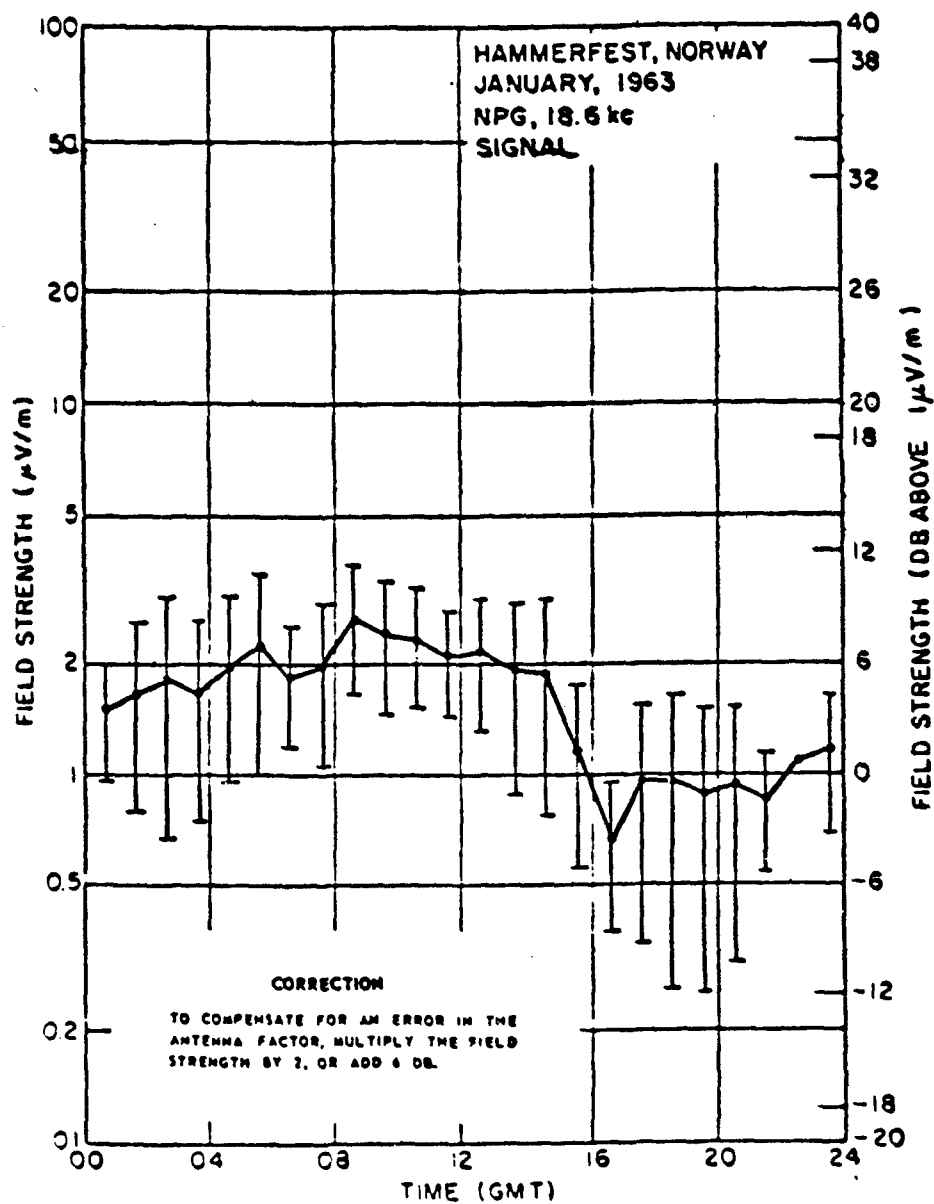


Figure 136

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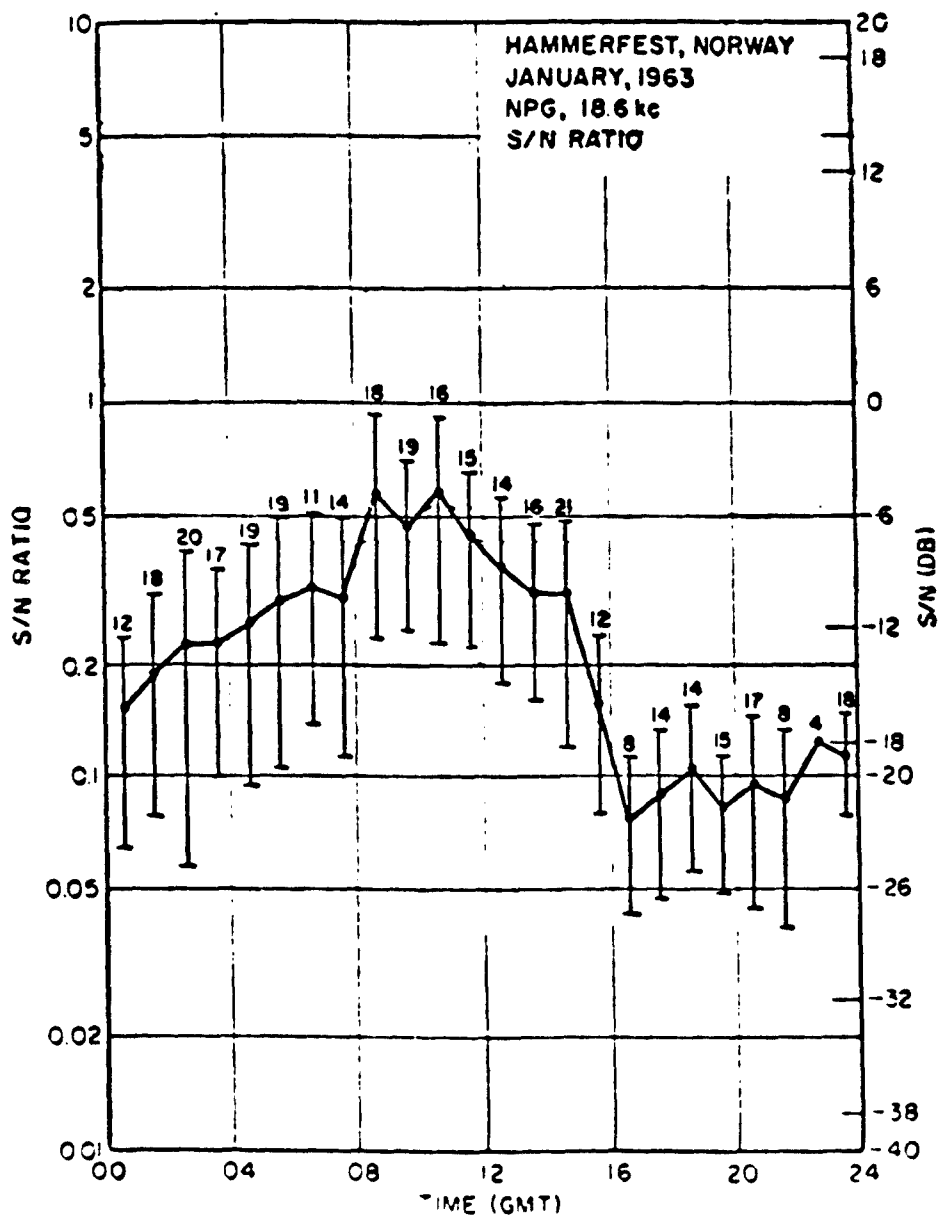


Figure 137

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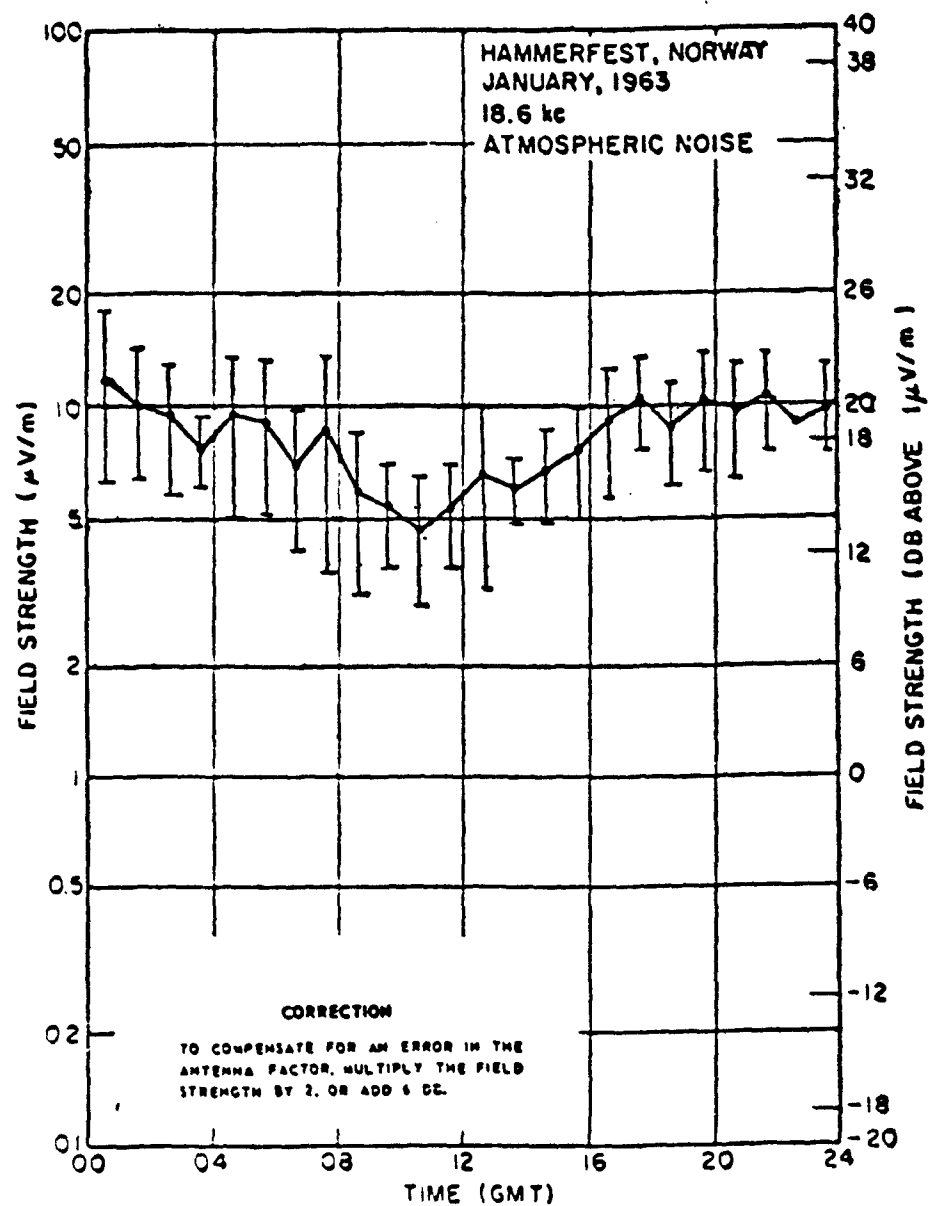


Figure 138

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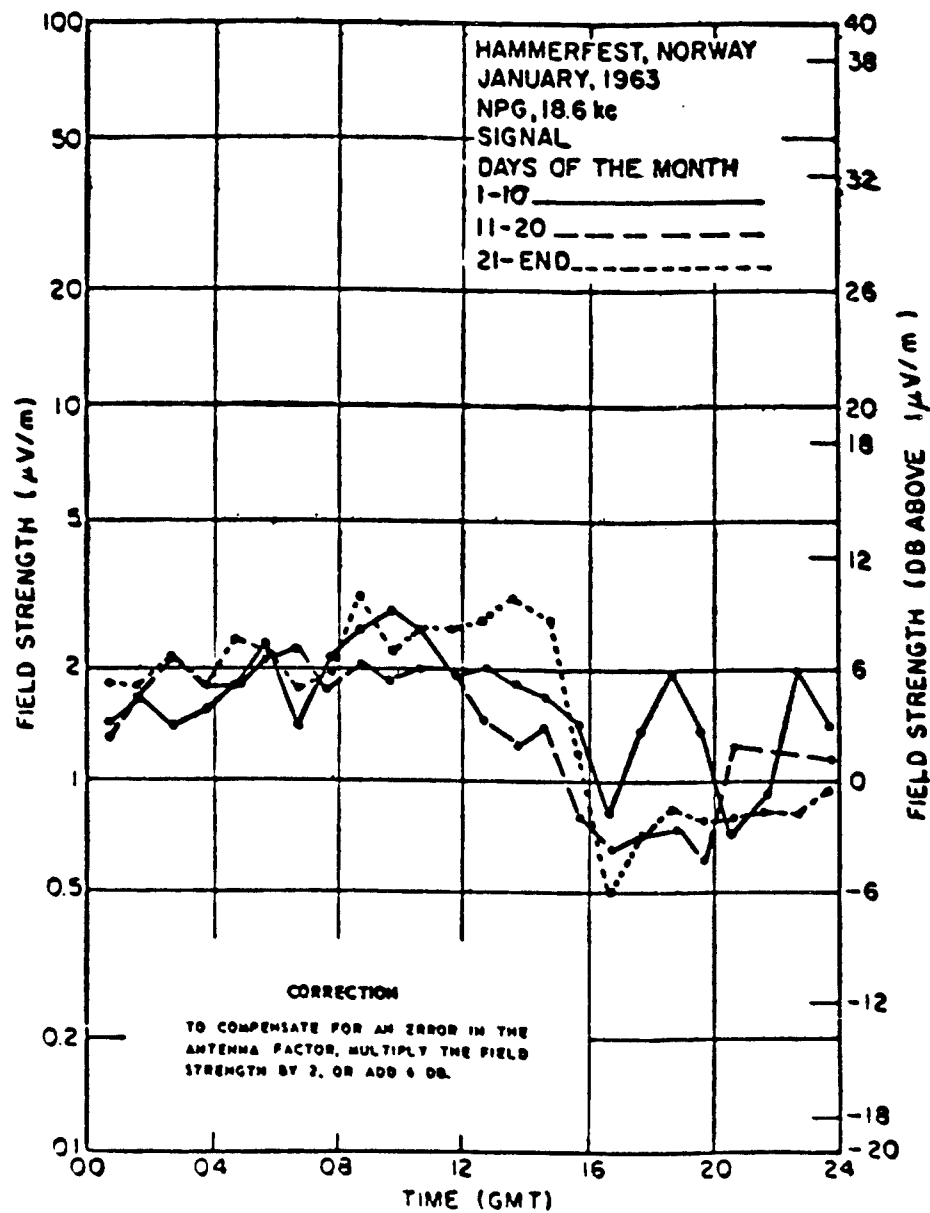


Figure 139

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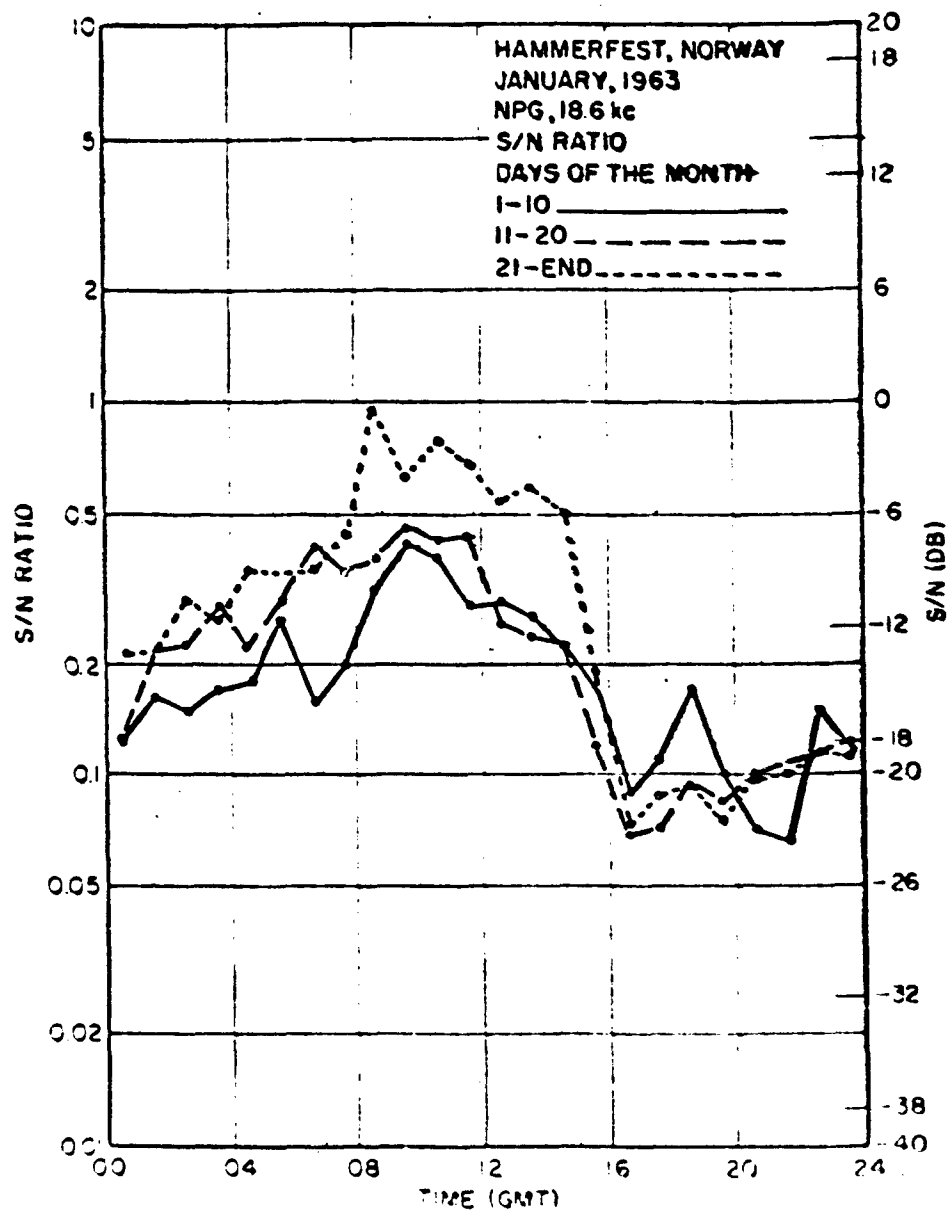


Figure 140

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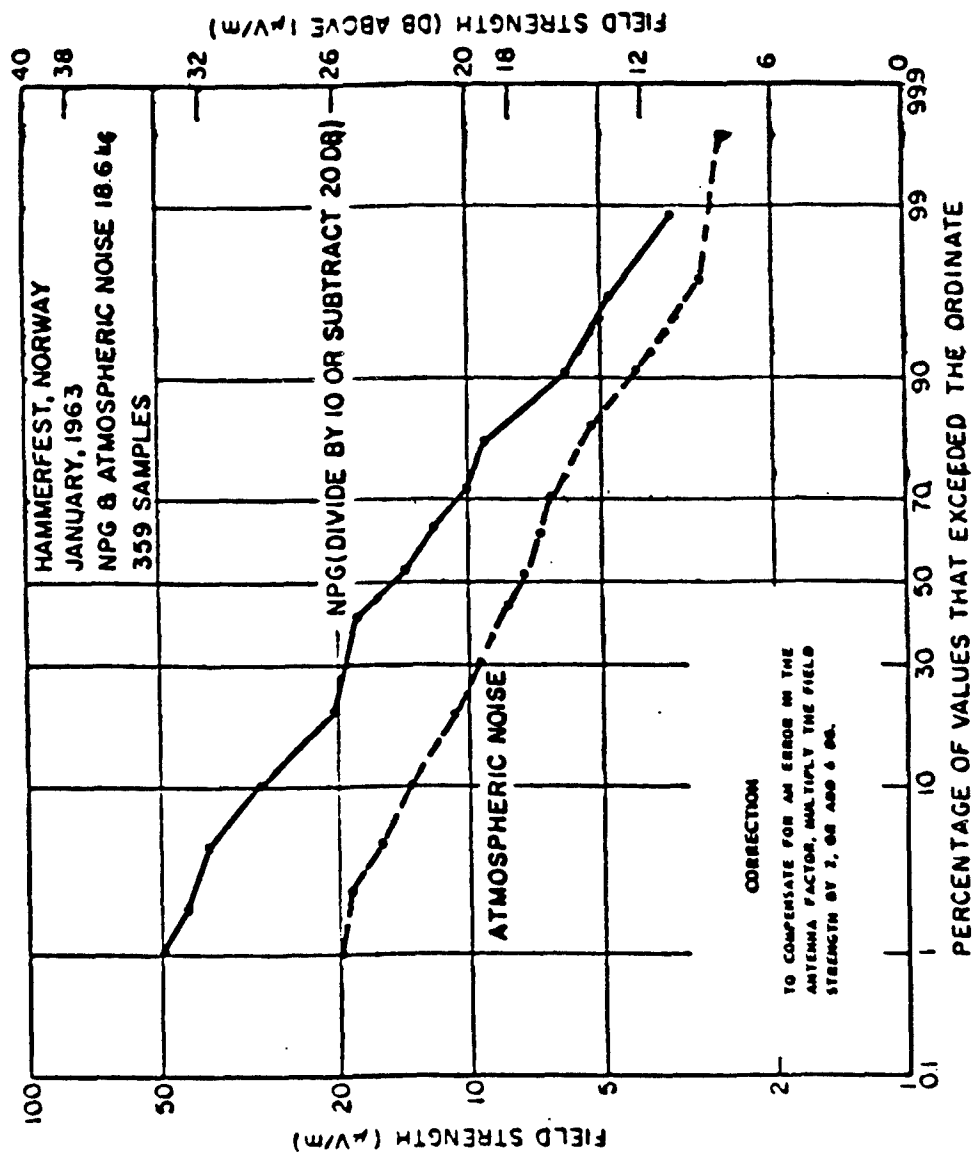


Figure 141

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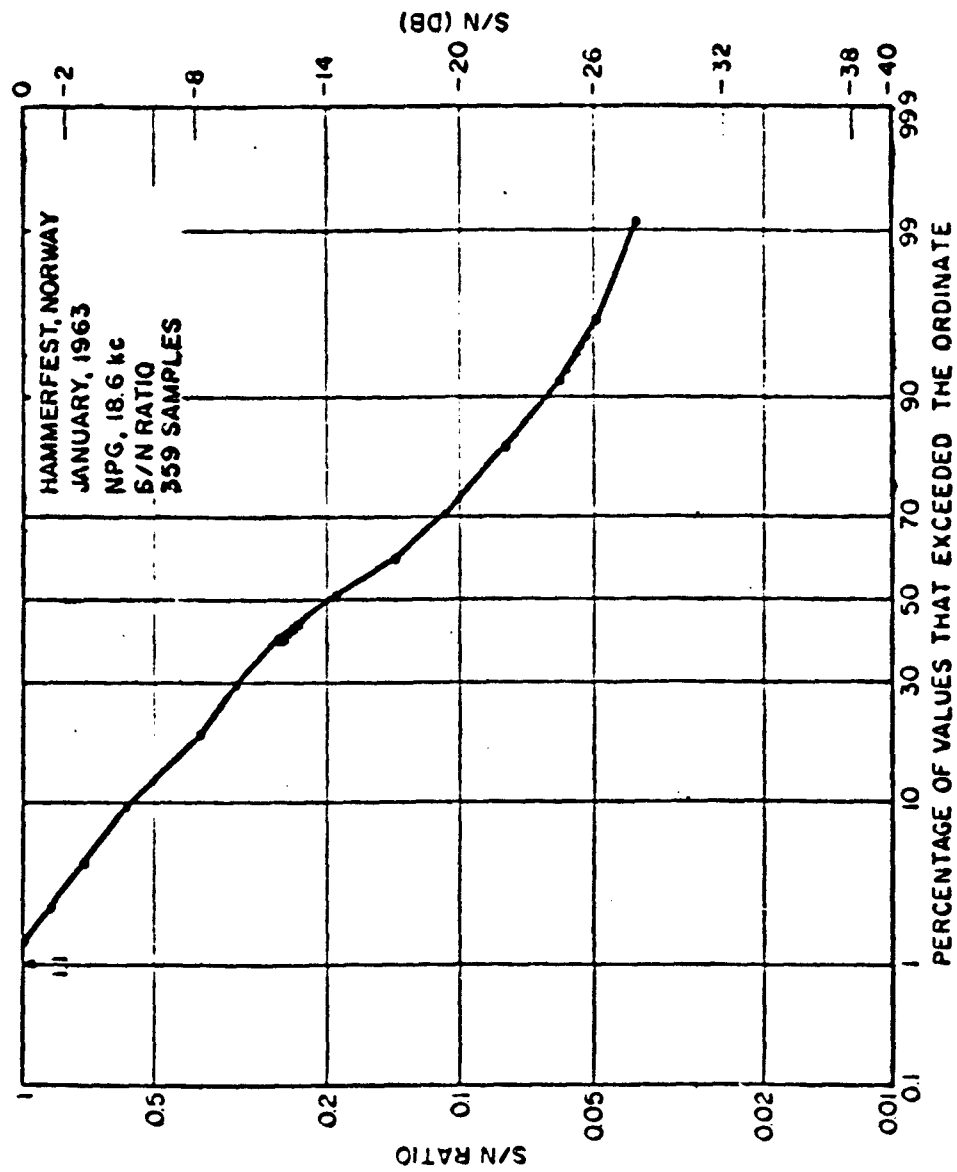


Figure 142

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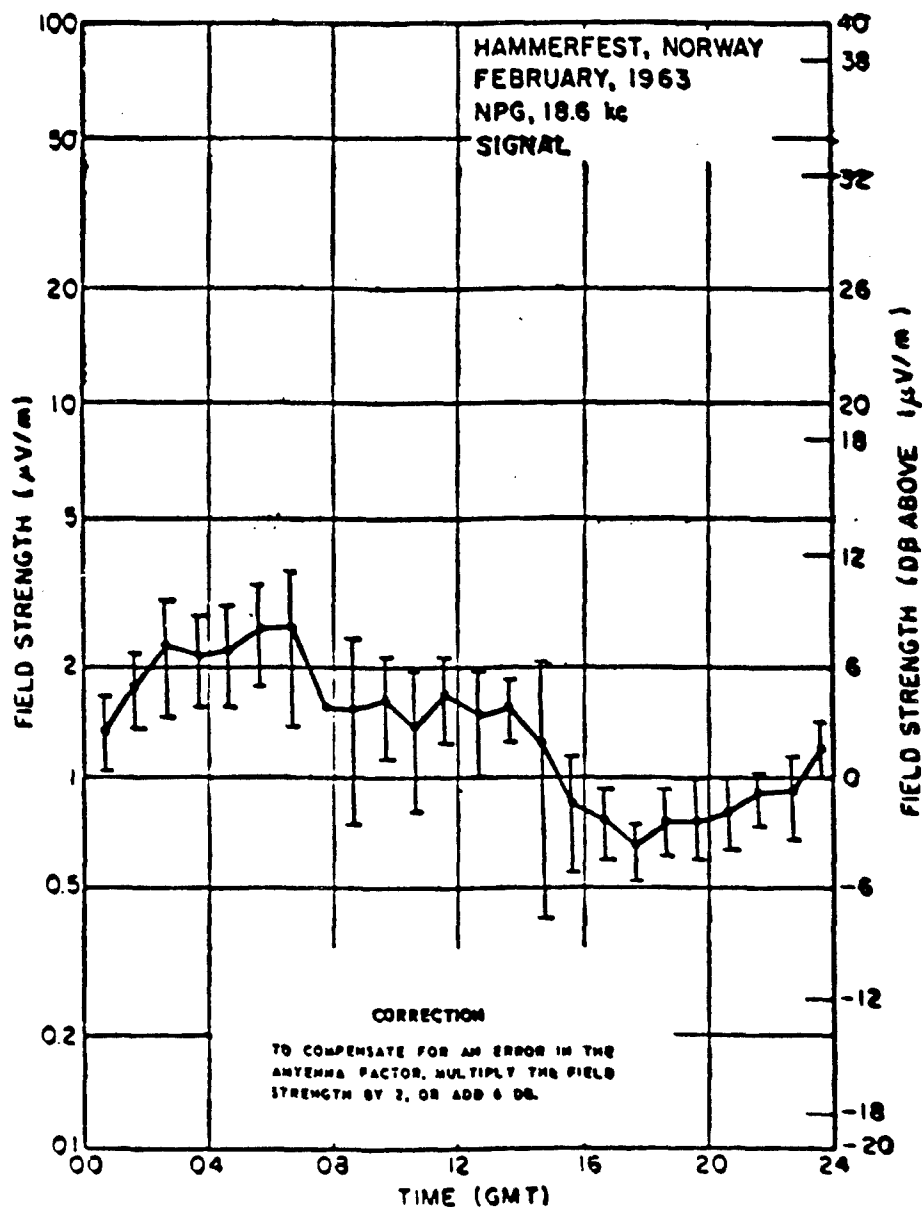


Figure 143

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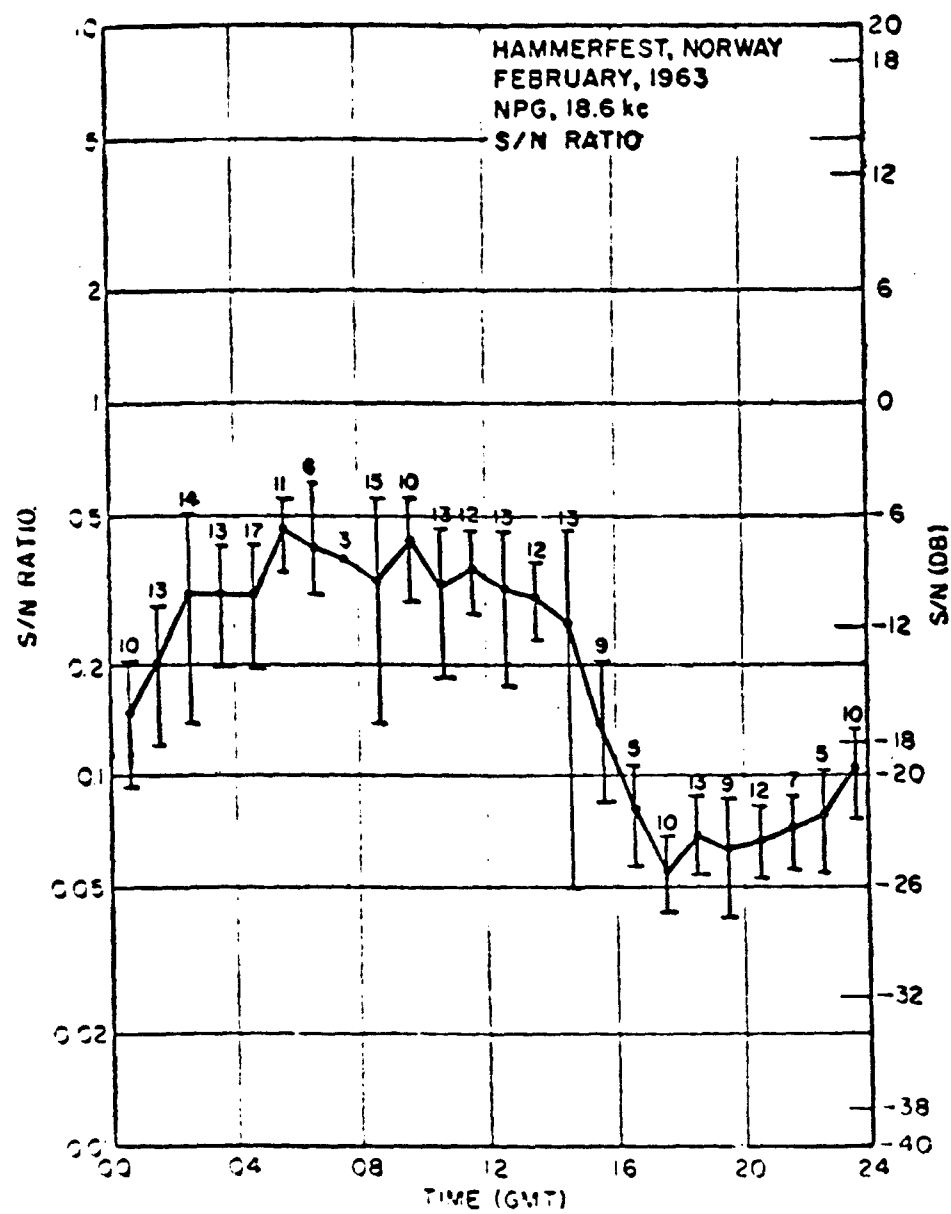


Figure 144

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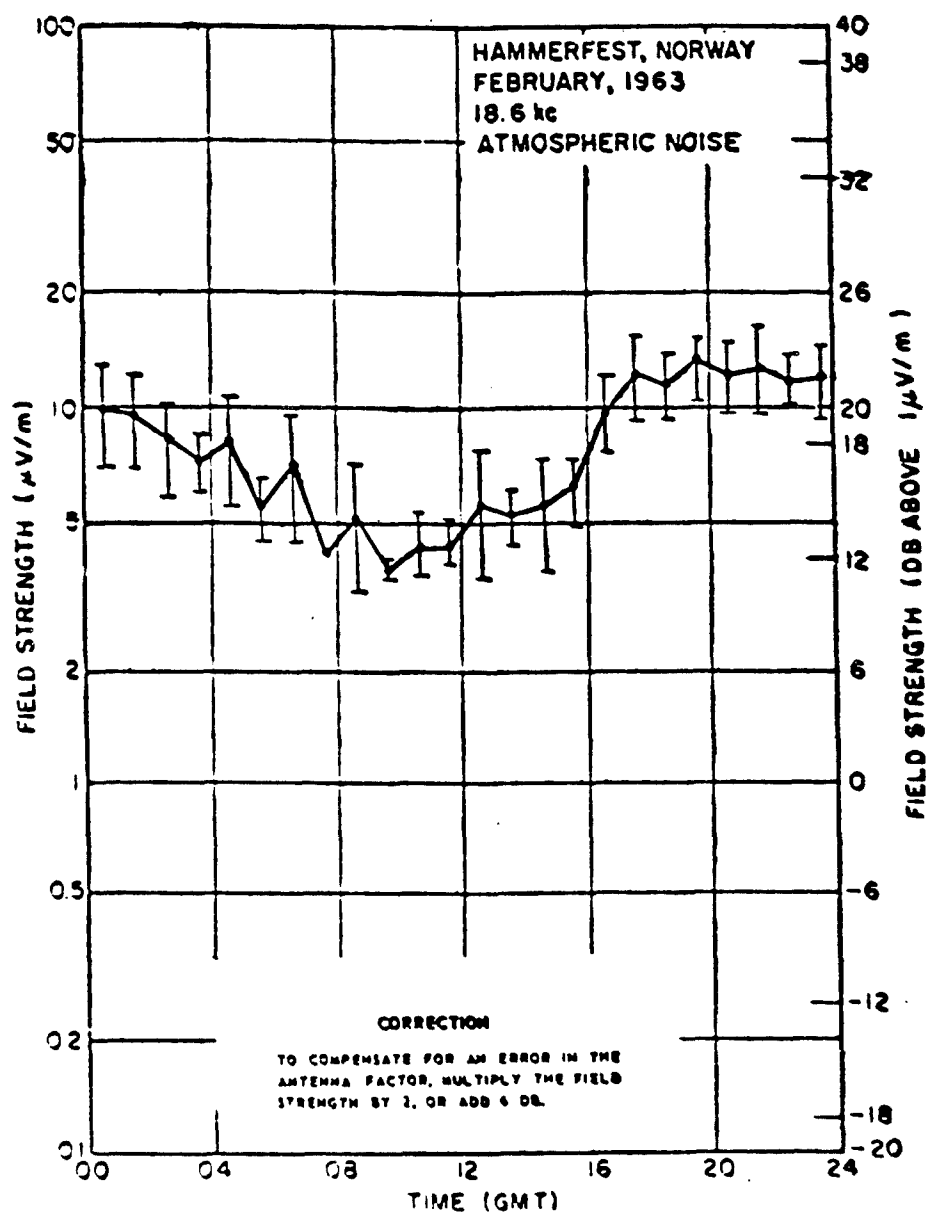


Figure 145

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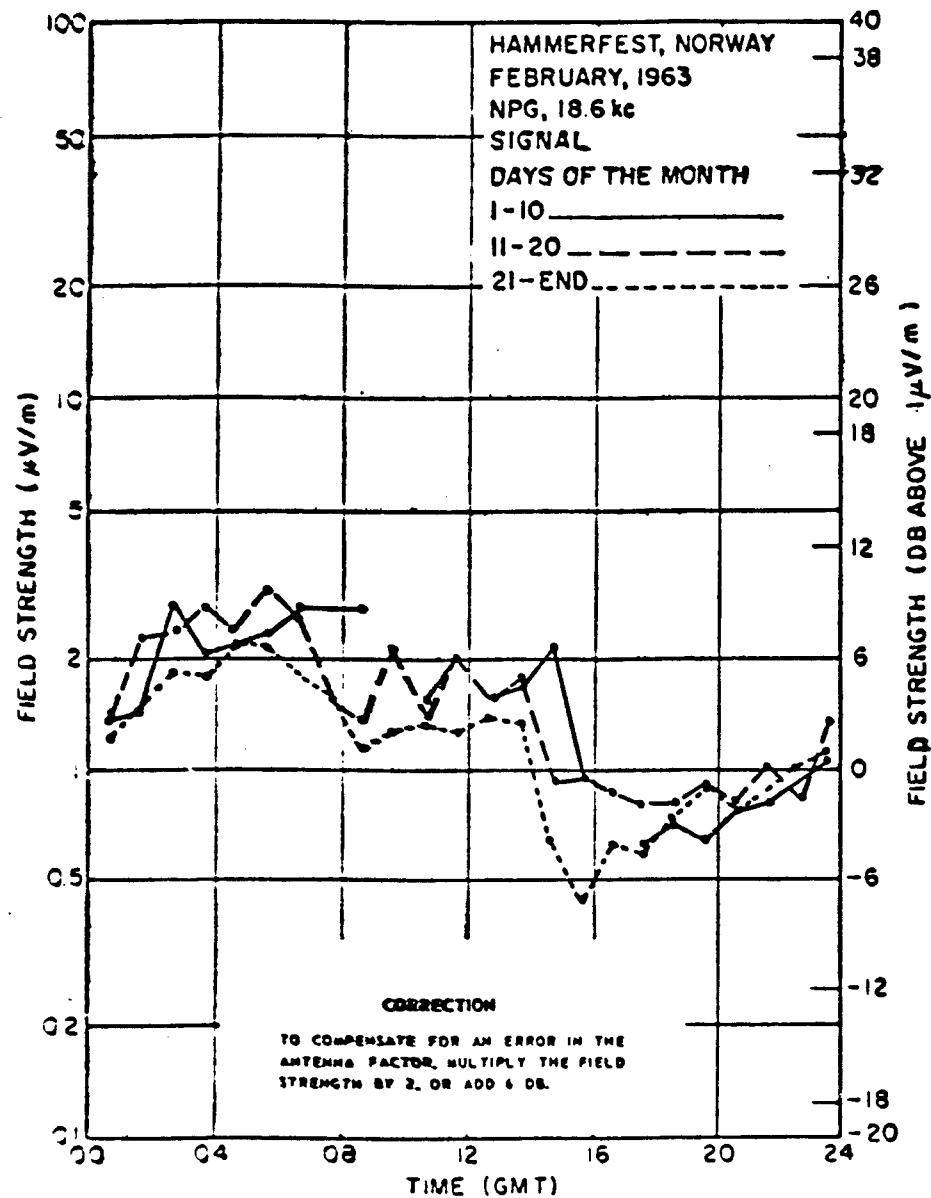


Figure 146

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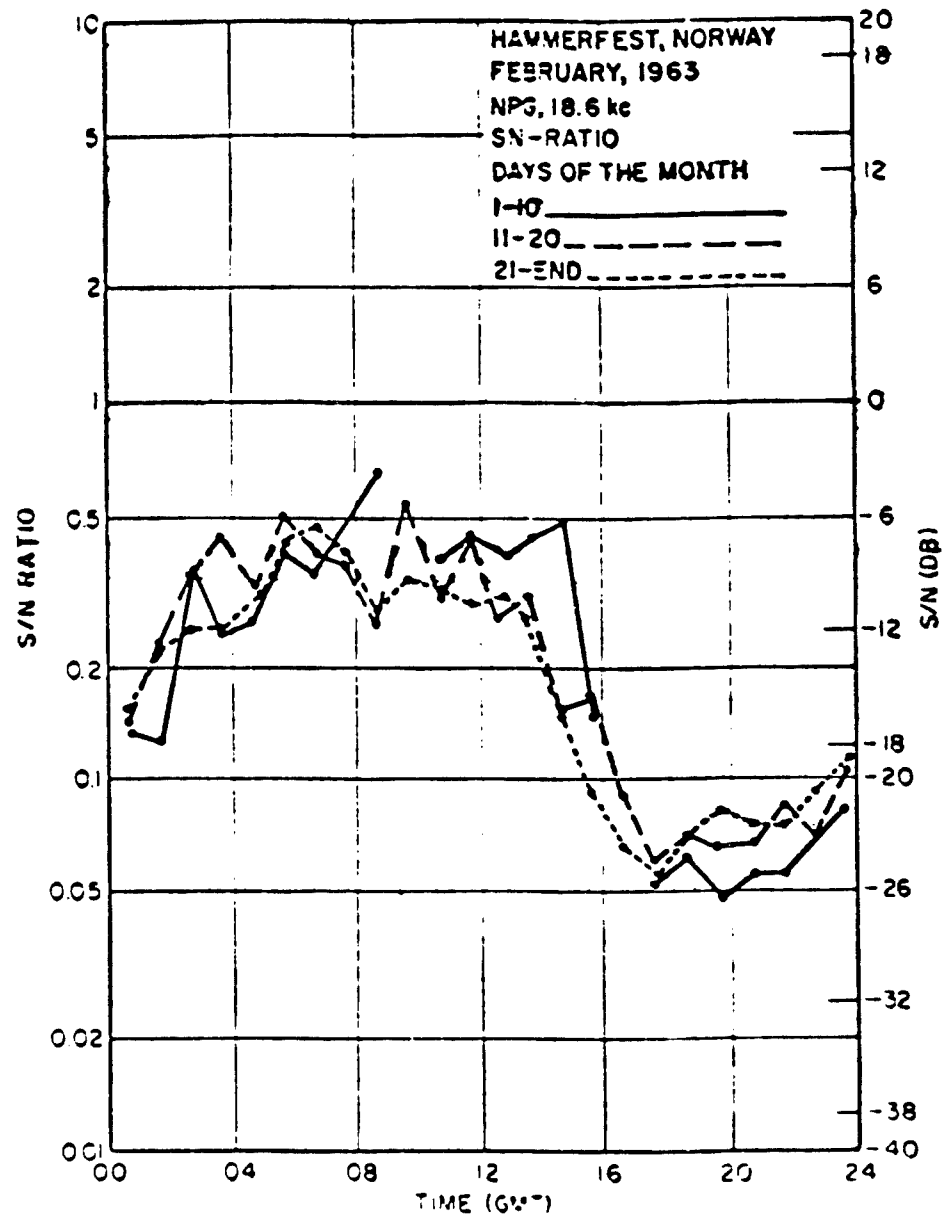


Figure 147

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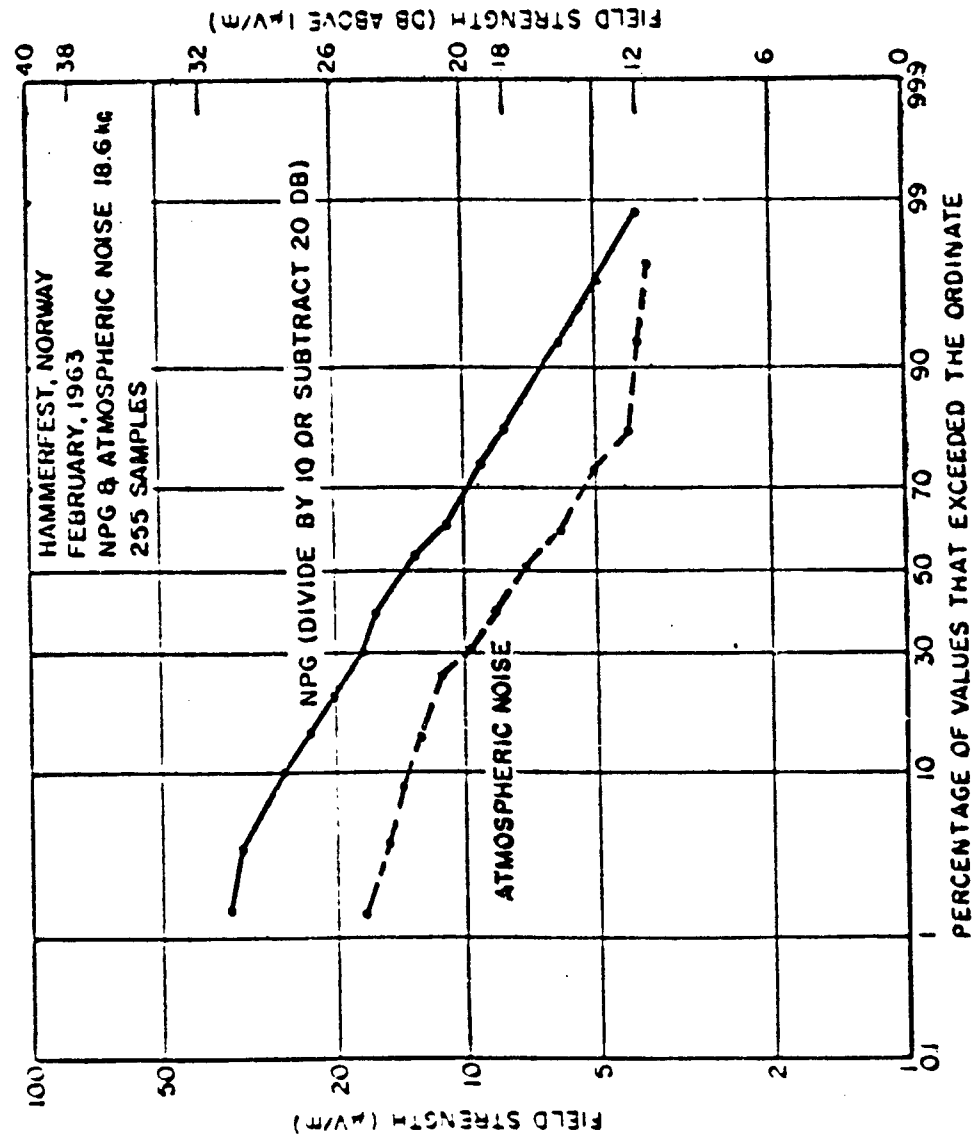


Figure 148

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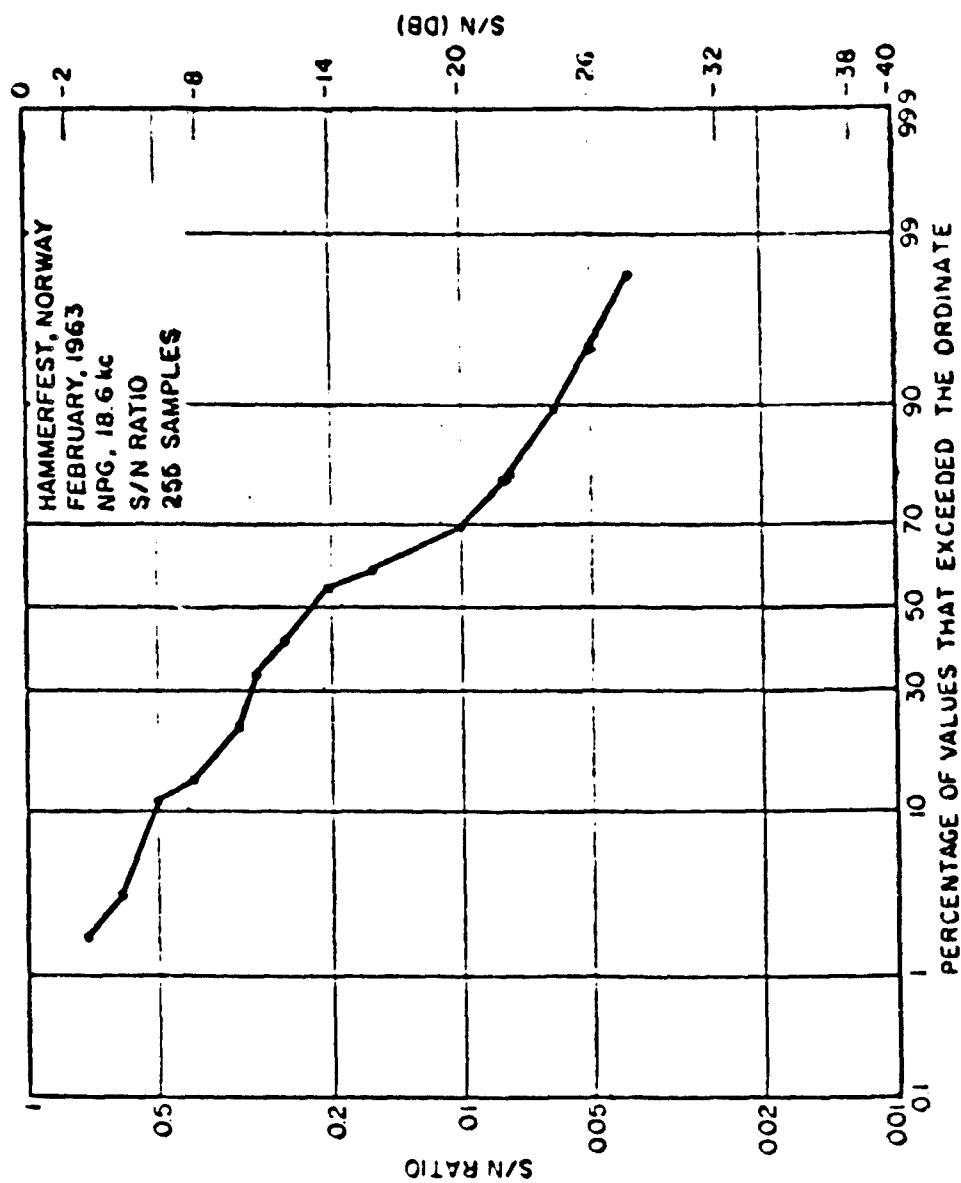


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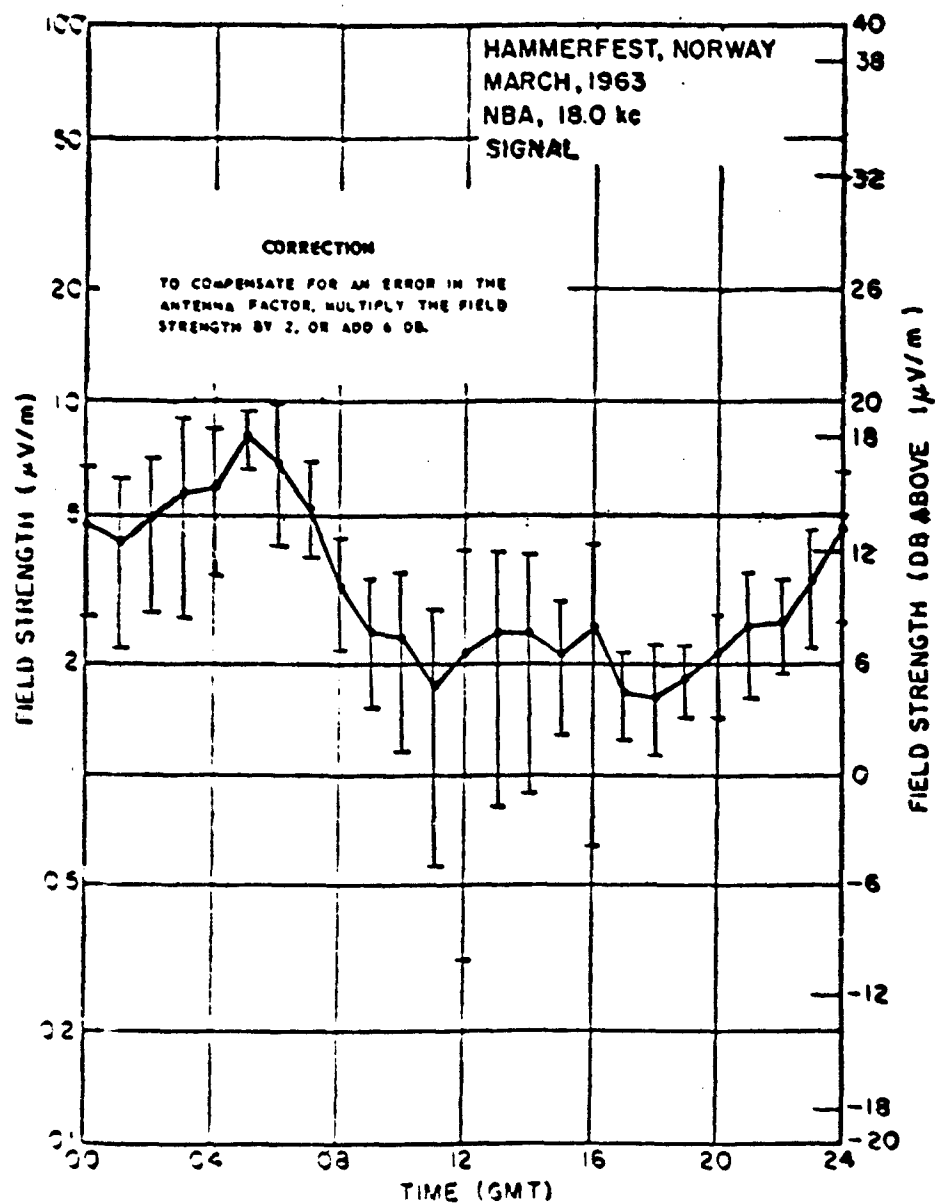


Figure 150

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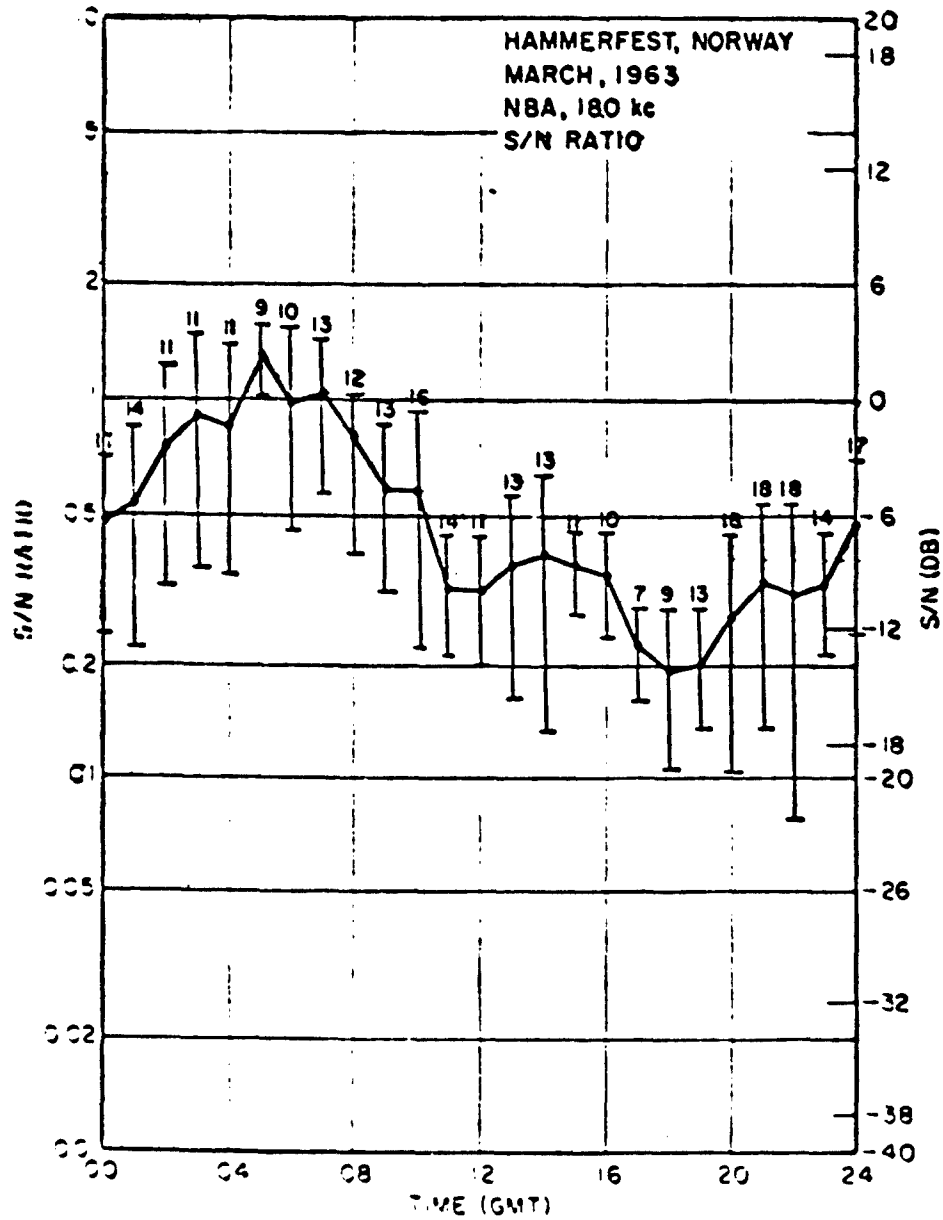


Figure 151

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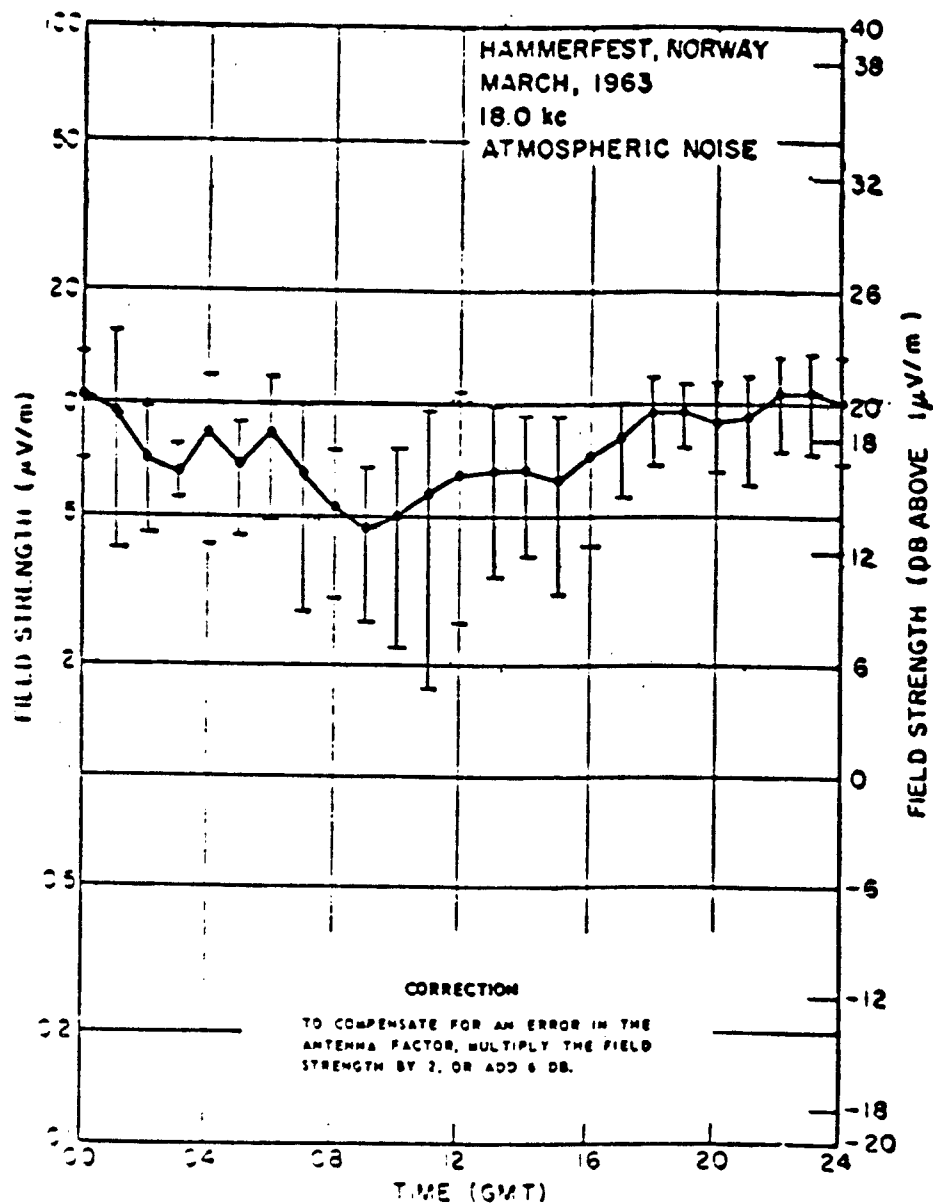


Figure 152

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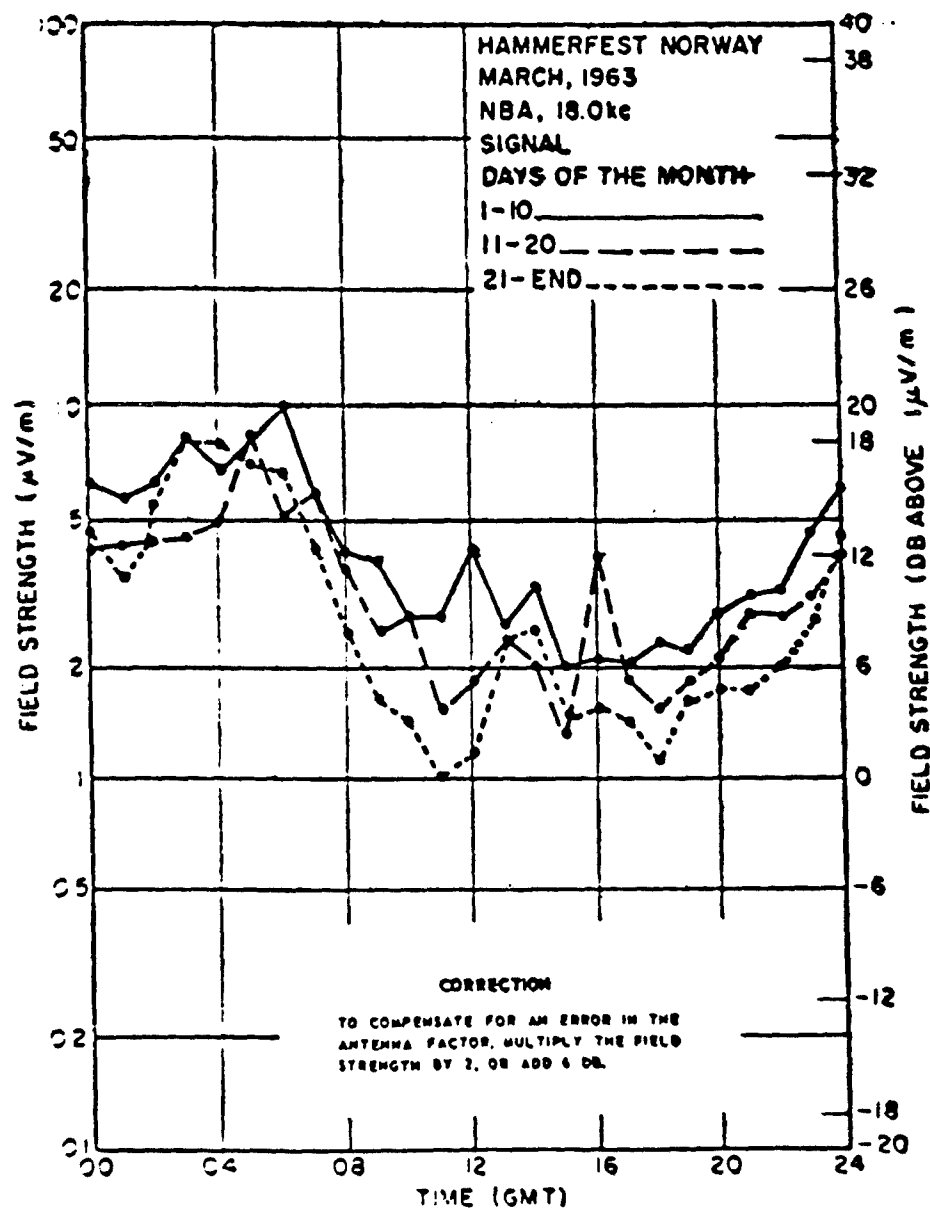


Figure 153

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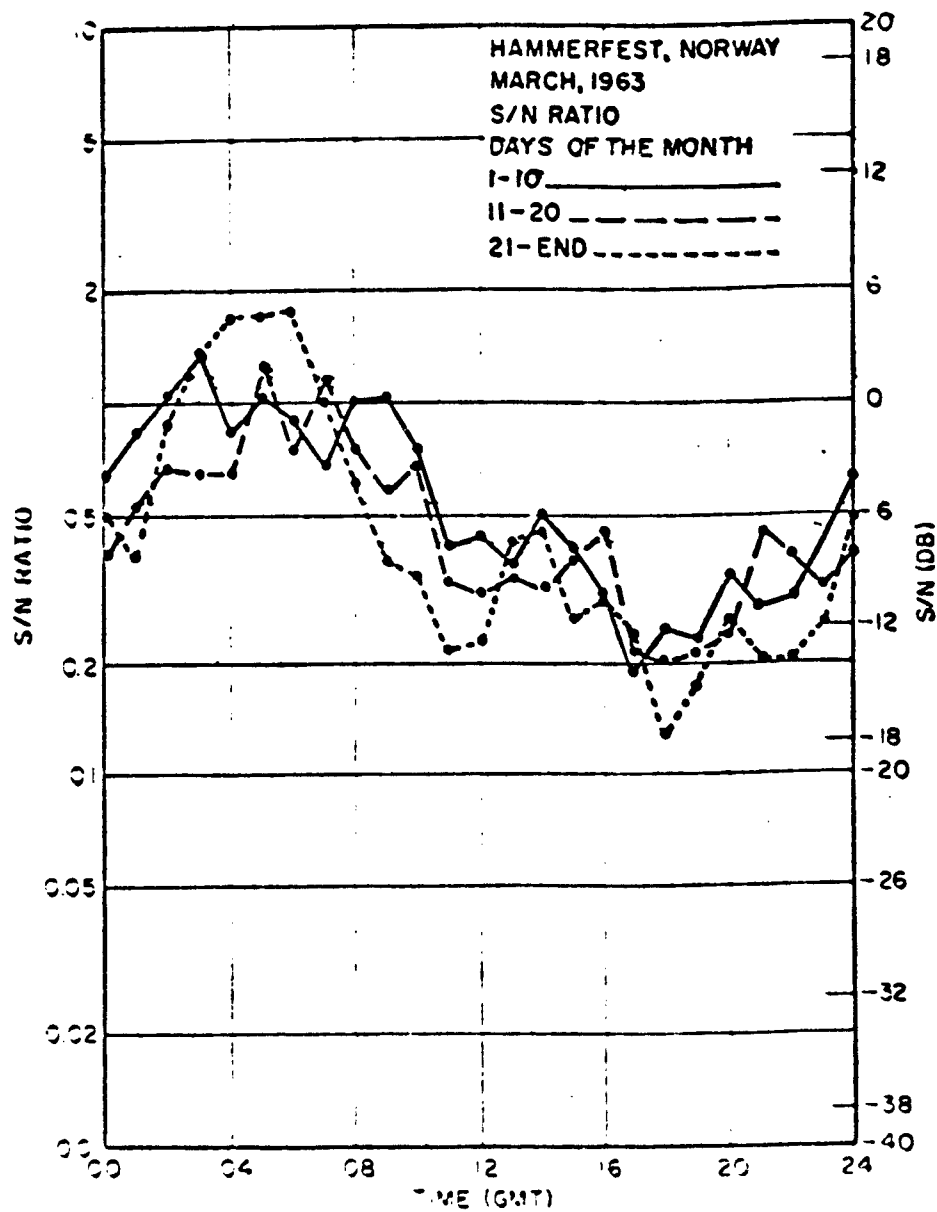


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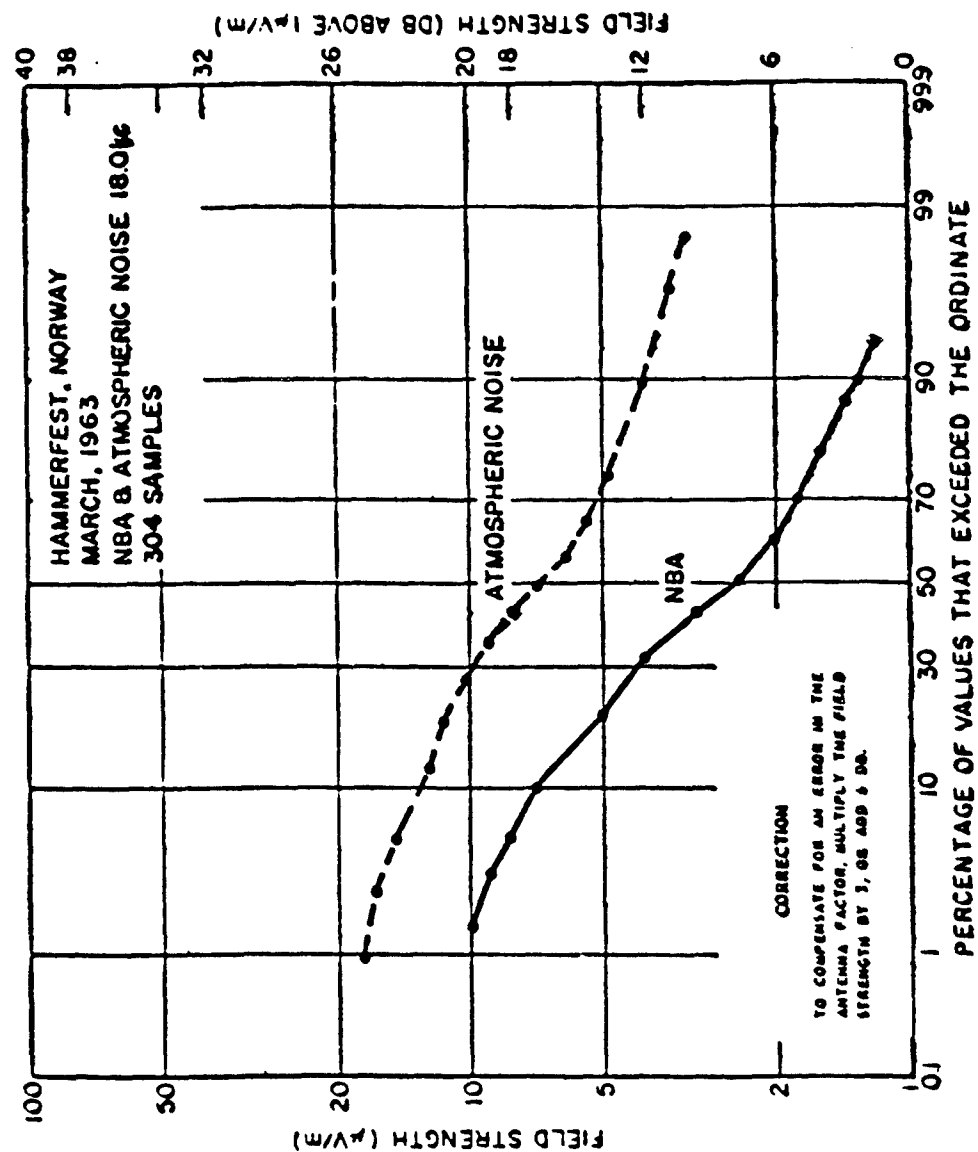


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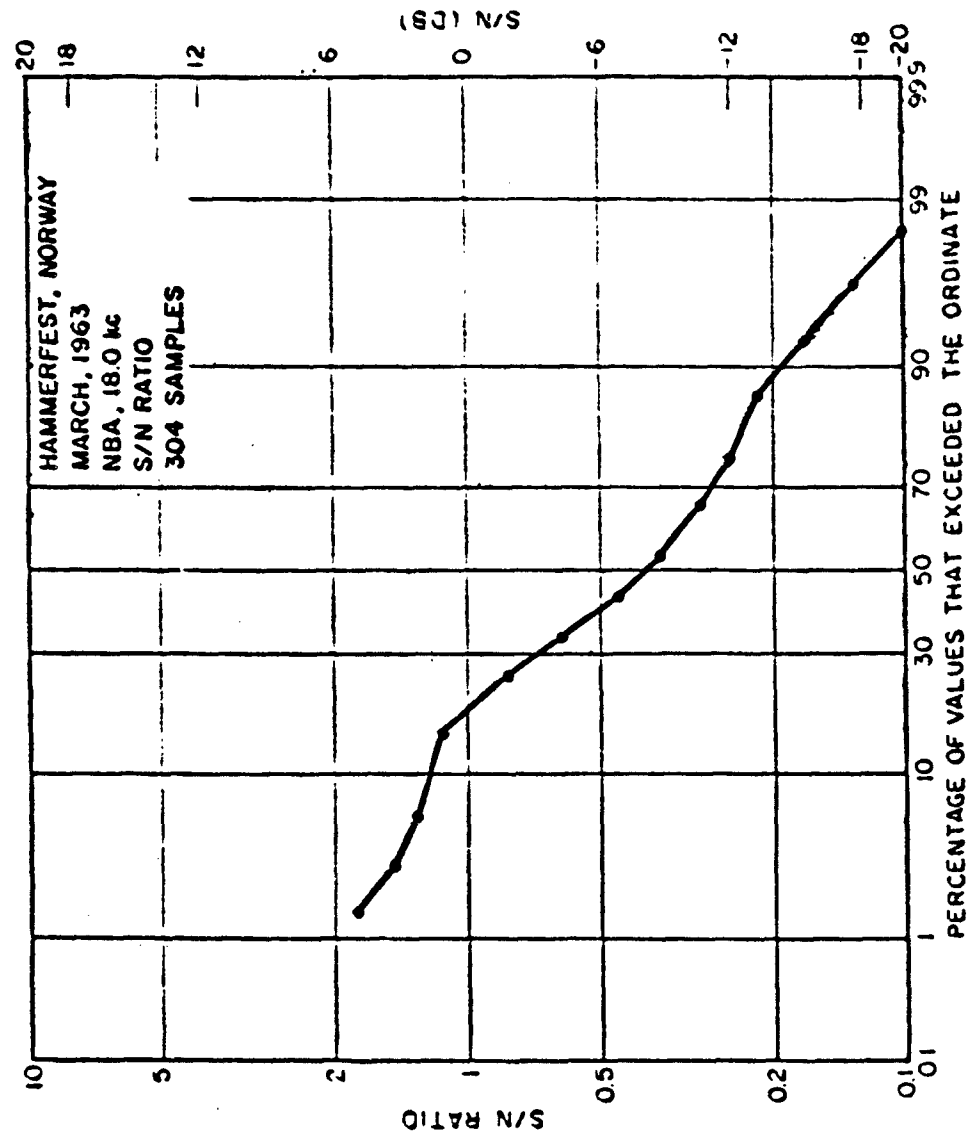


Figure 156

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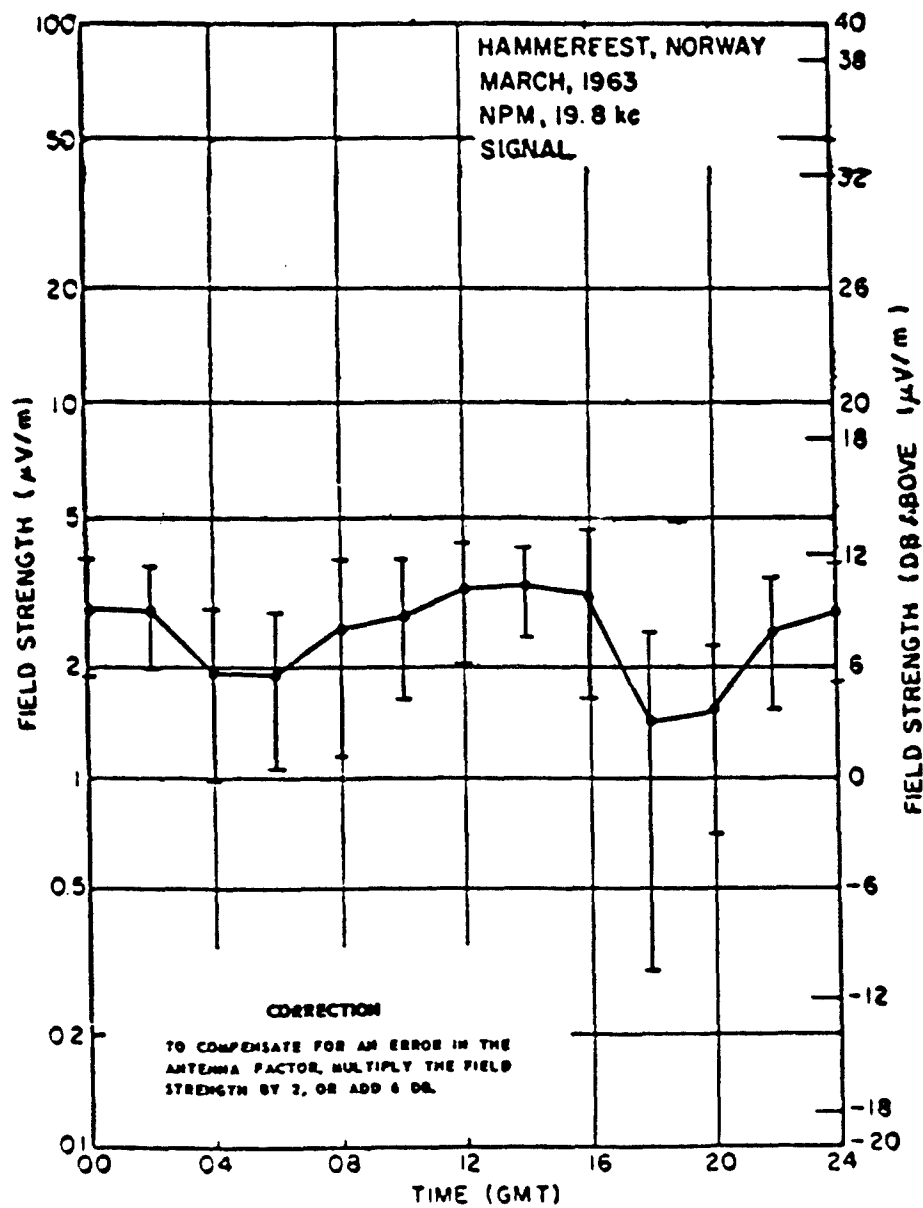


Figure 157

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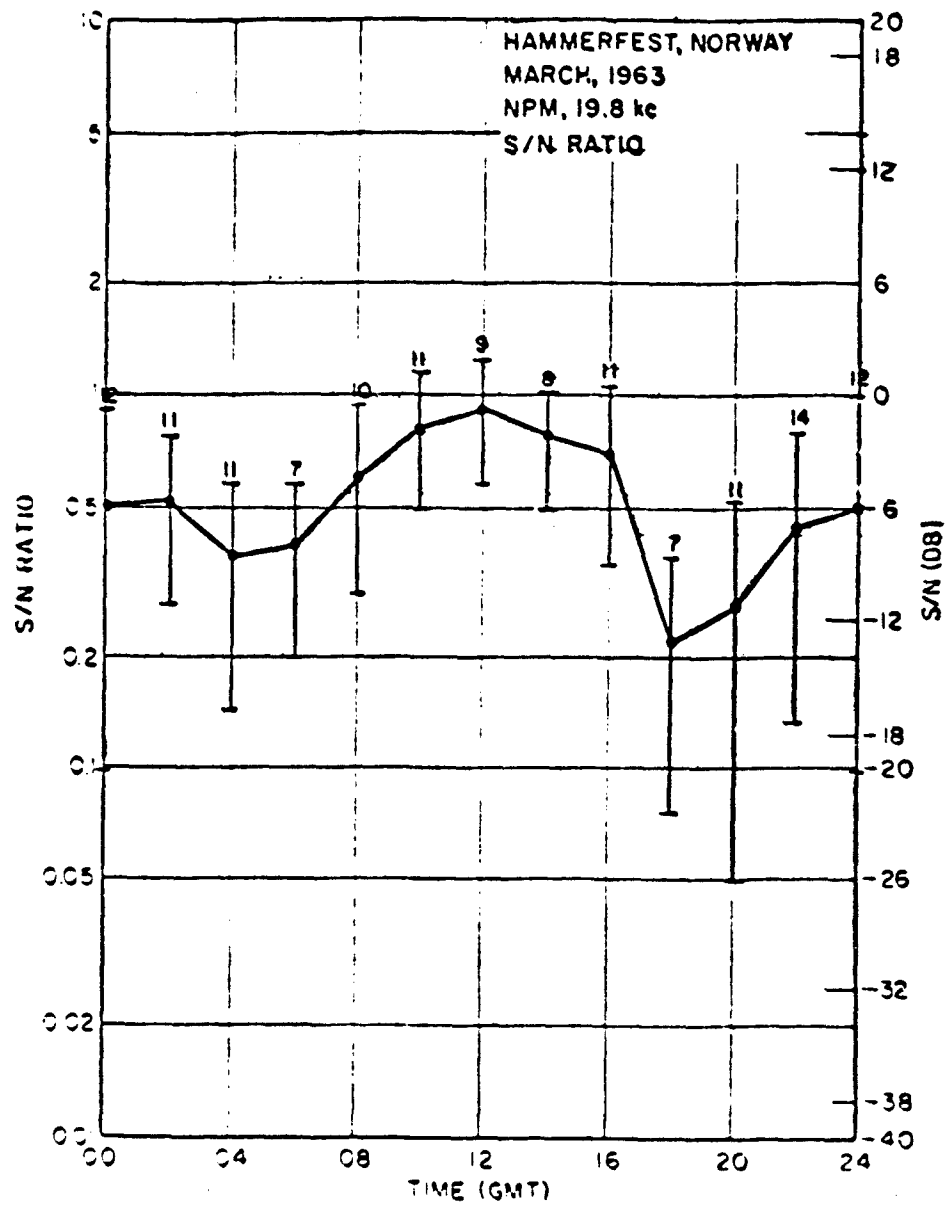


Figure 158

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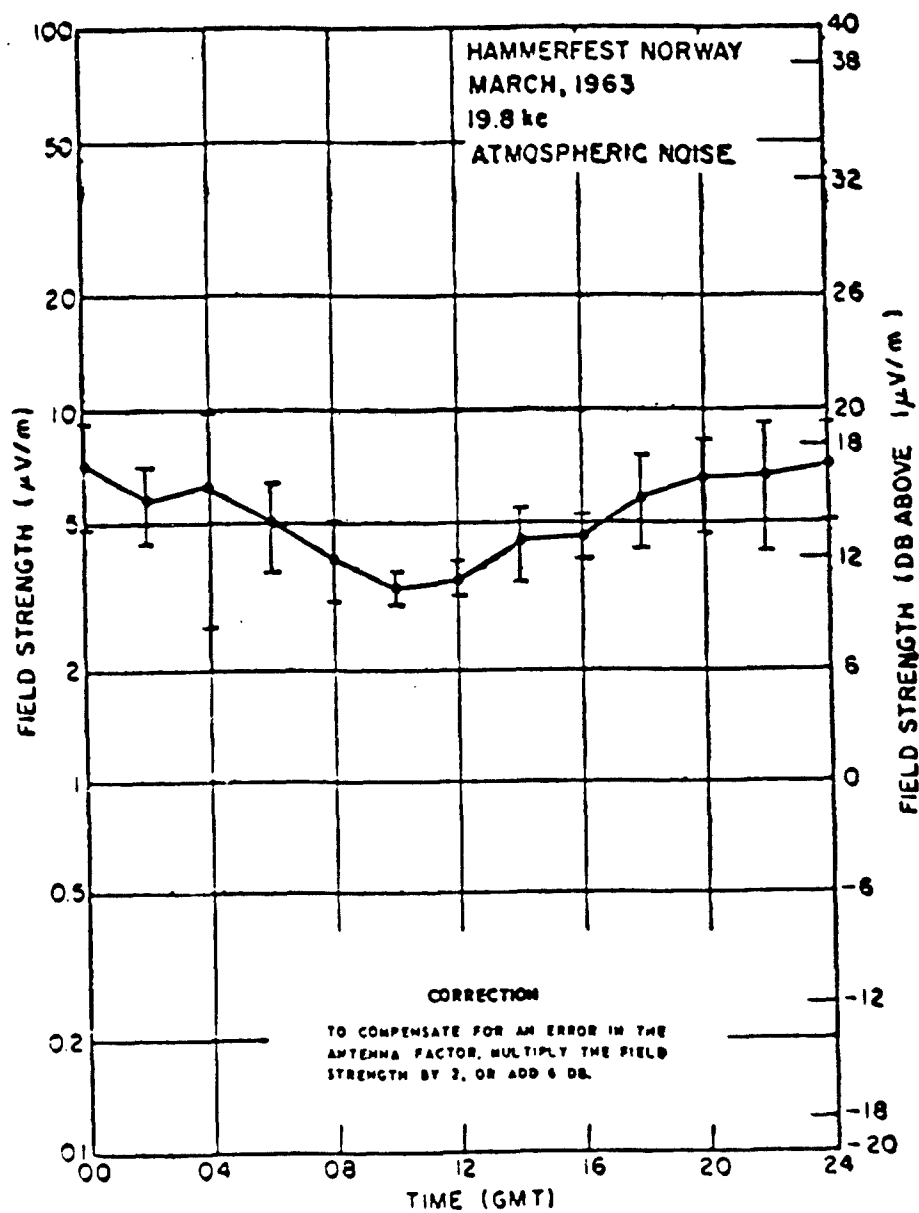


Figure 159

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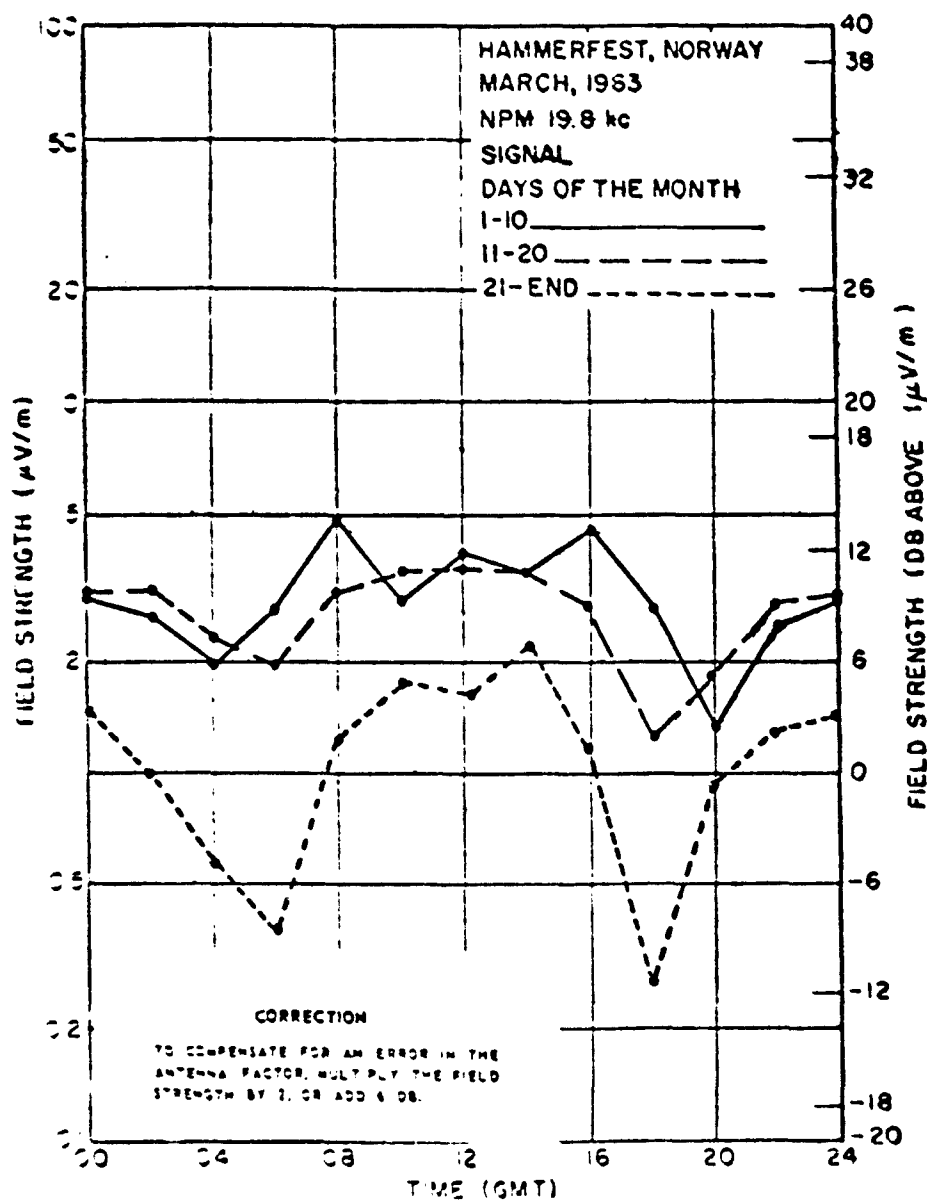


Figure 160

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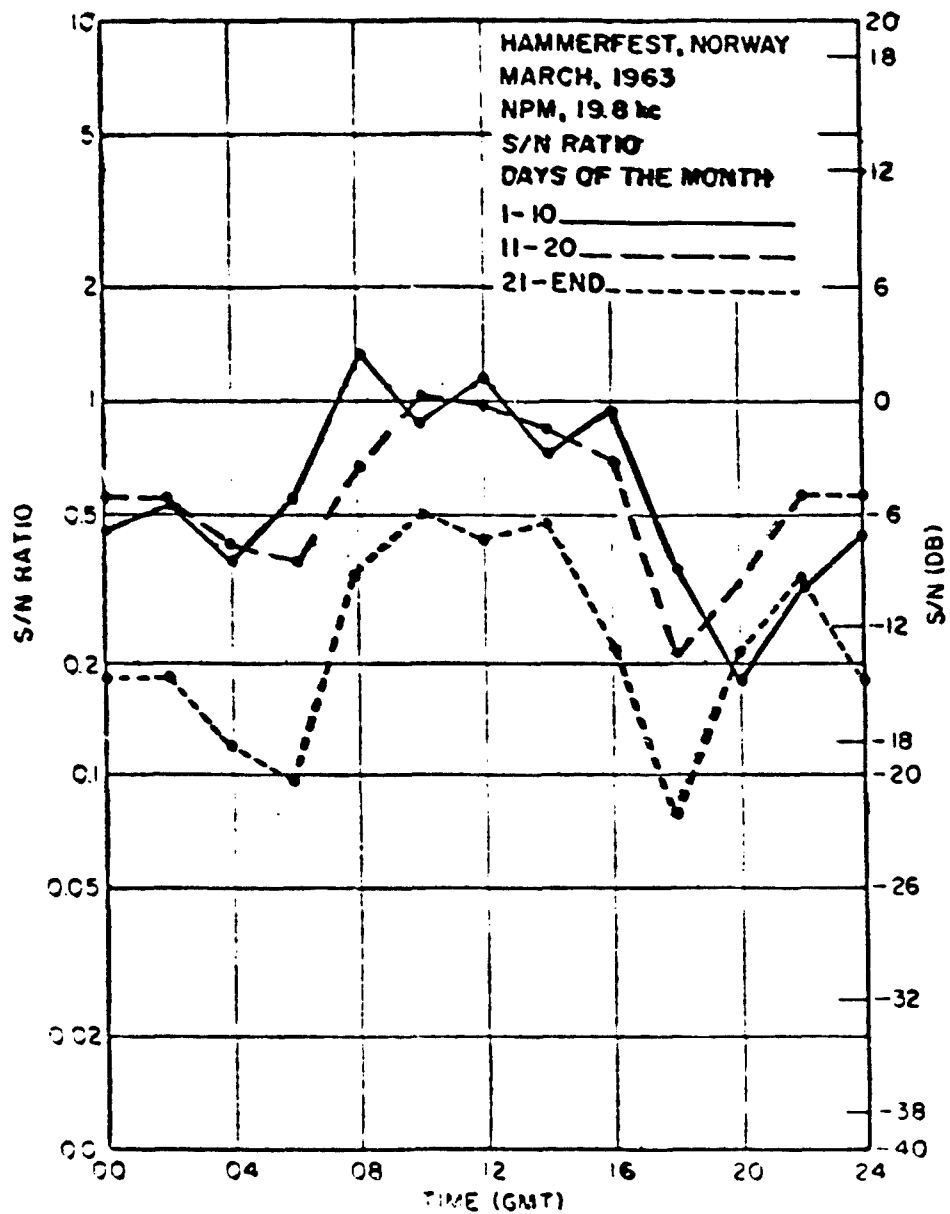


Figure 161

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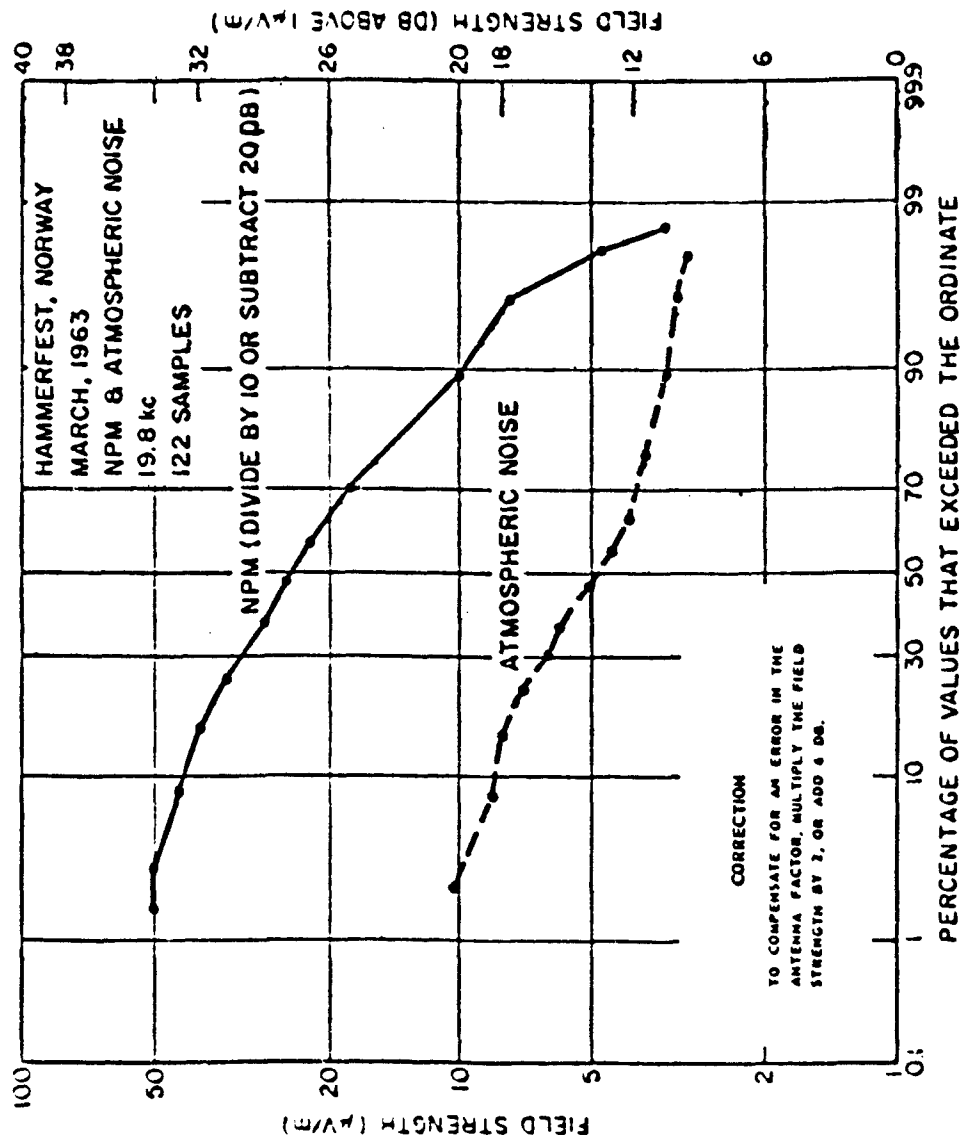


Figure 162

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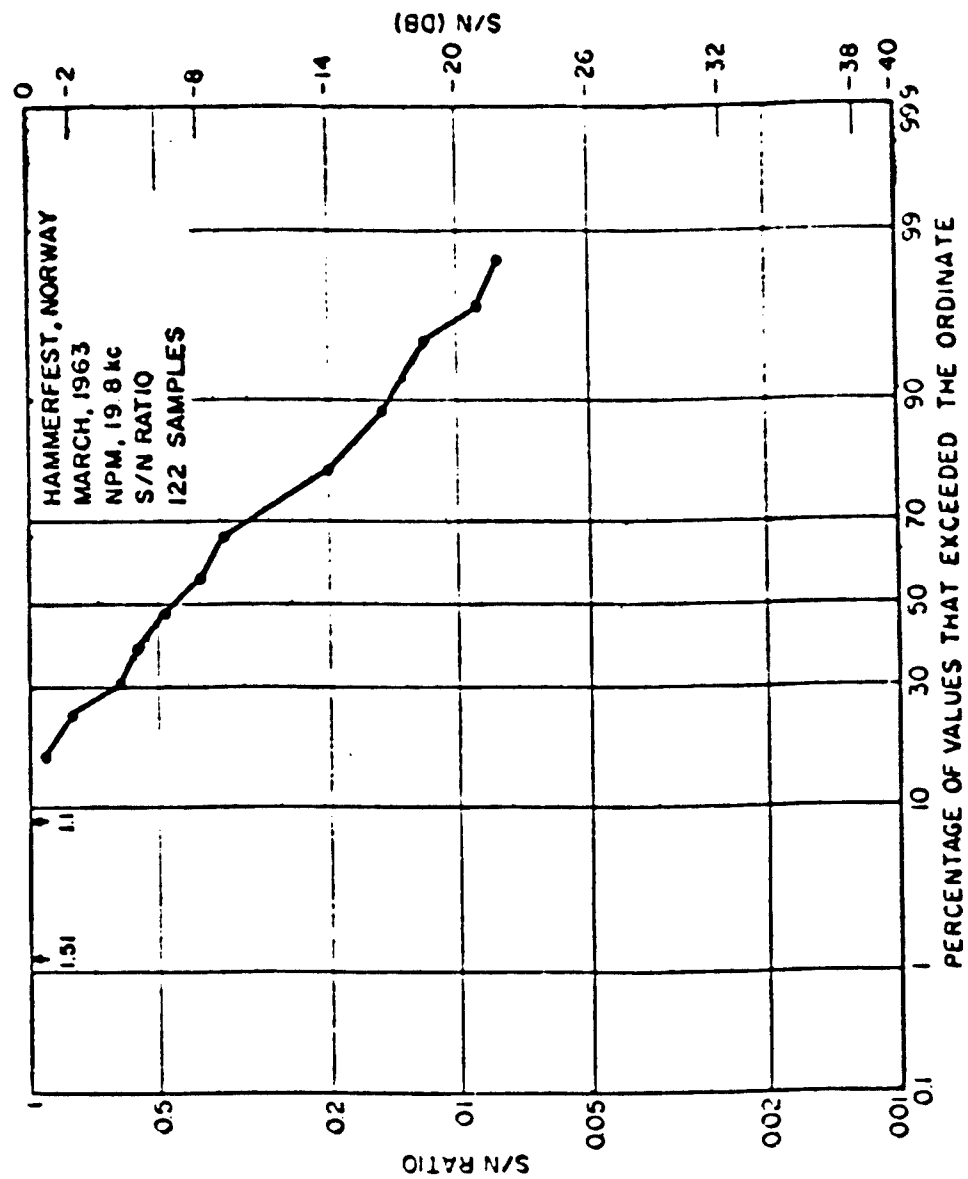


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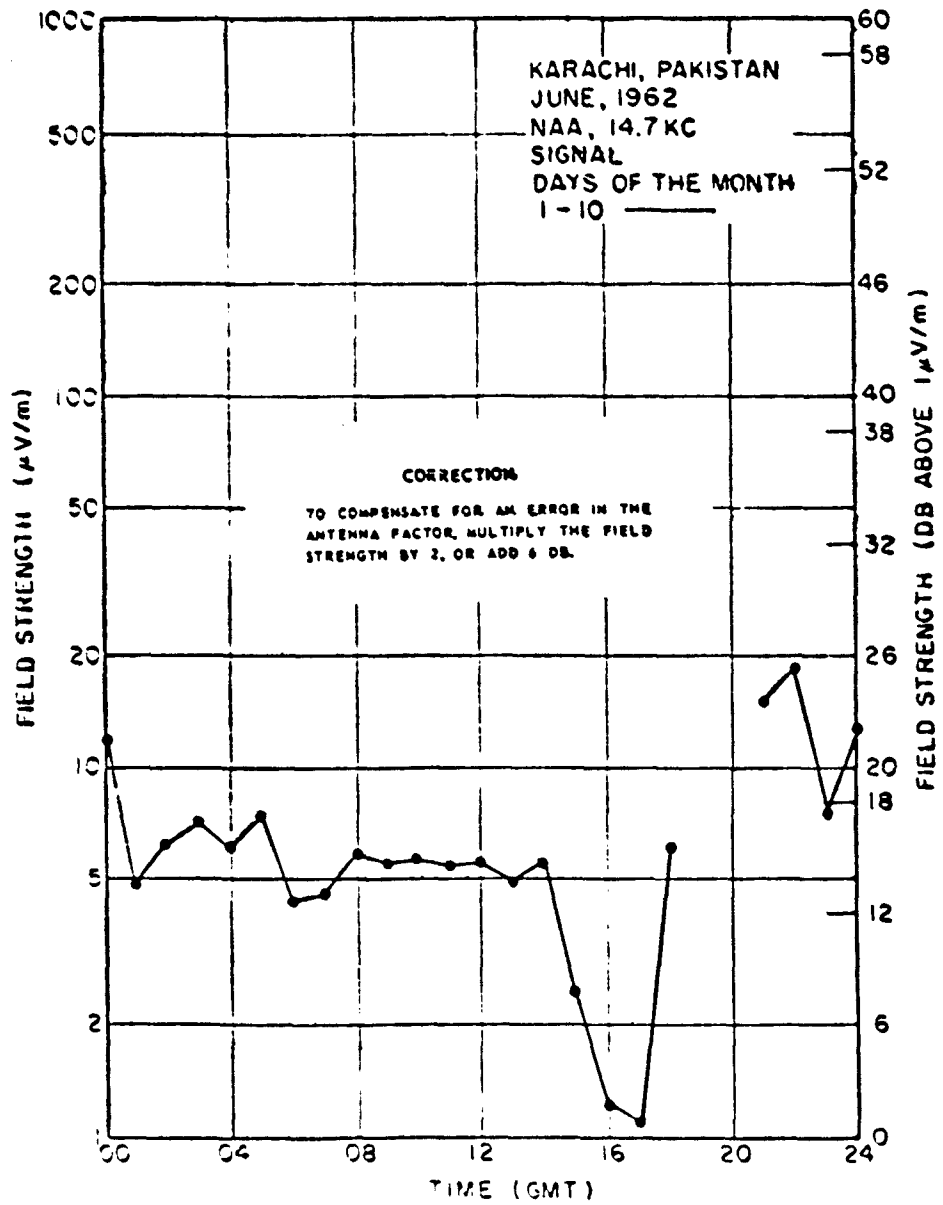


Figure 164

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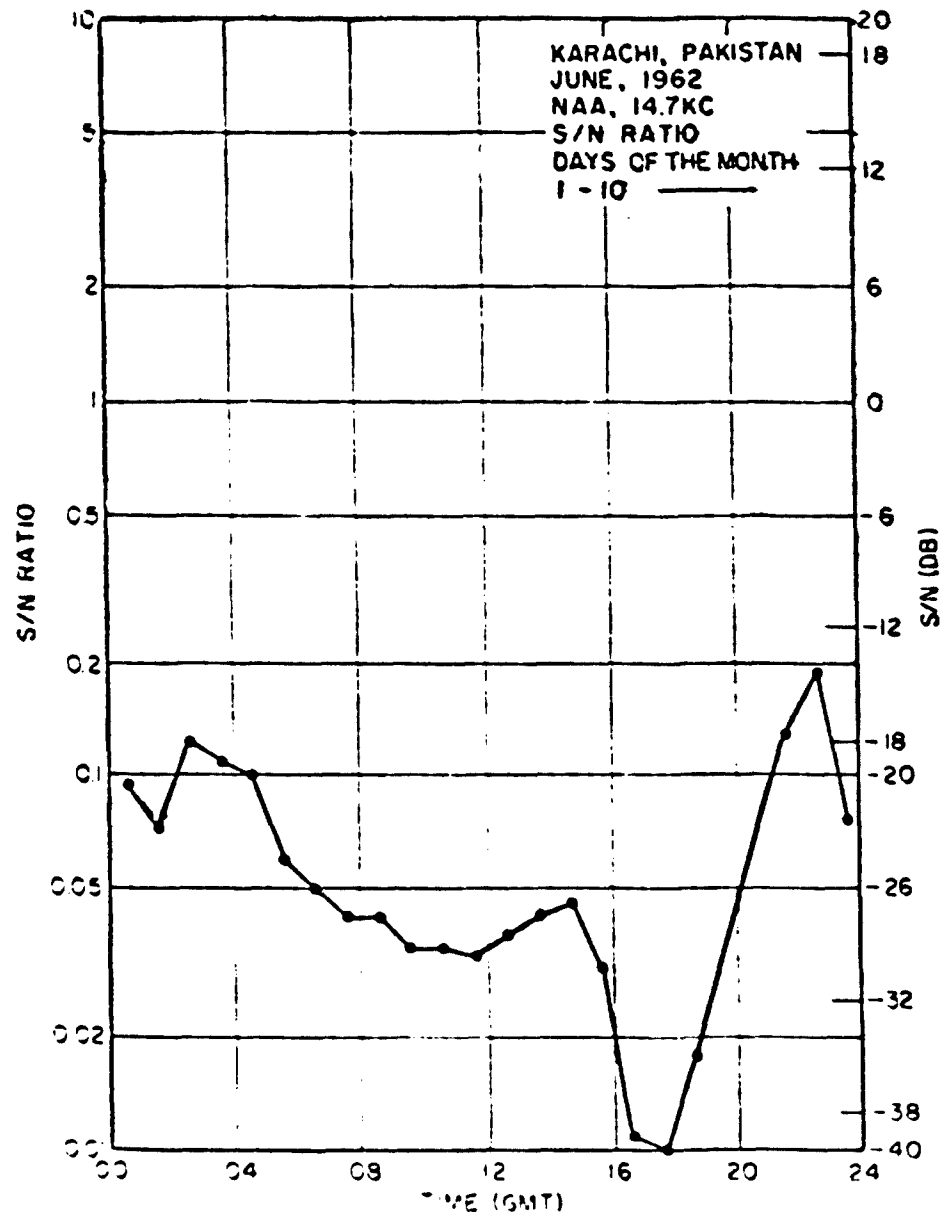


Figure 165

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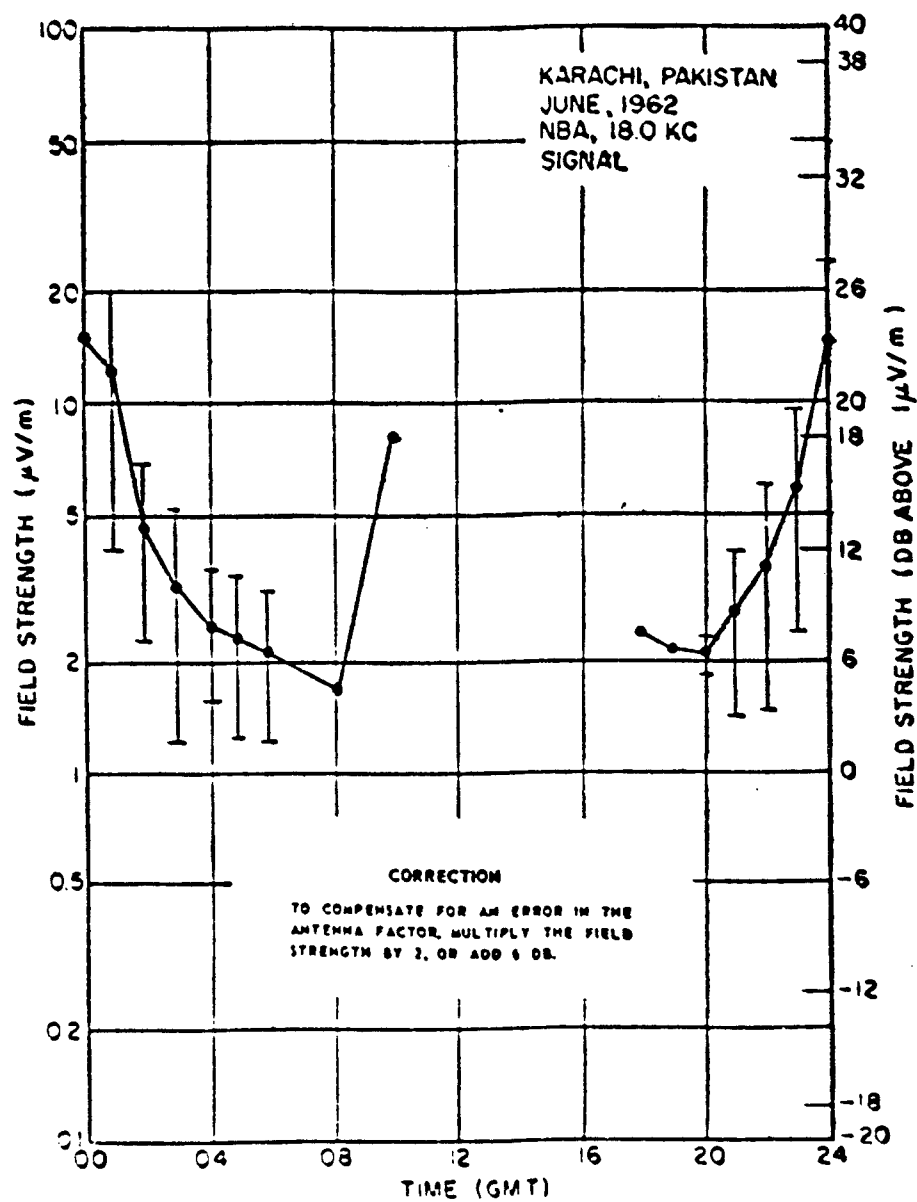


Figure 108

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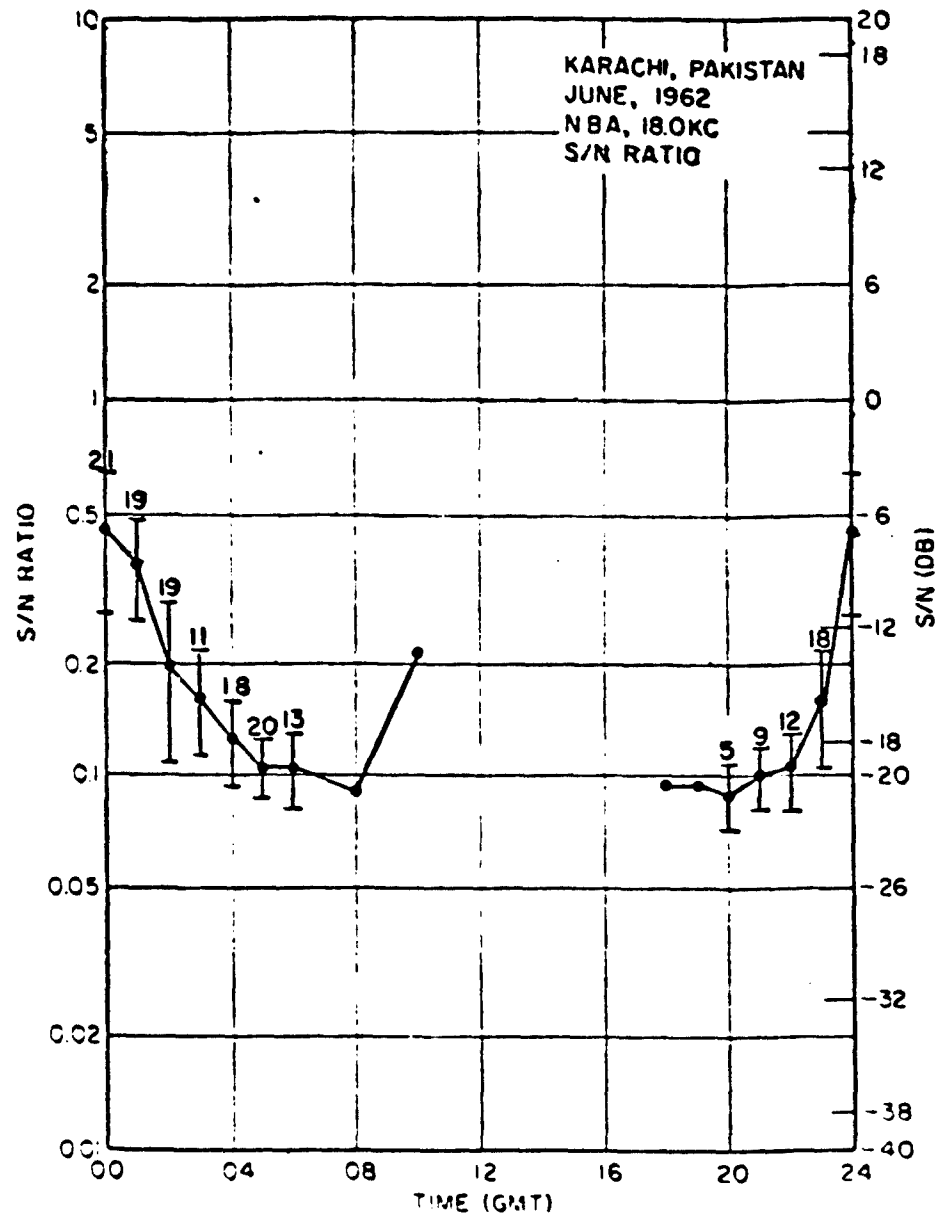


Figure 167

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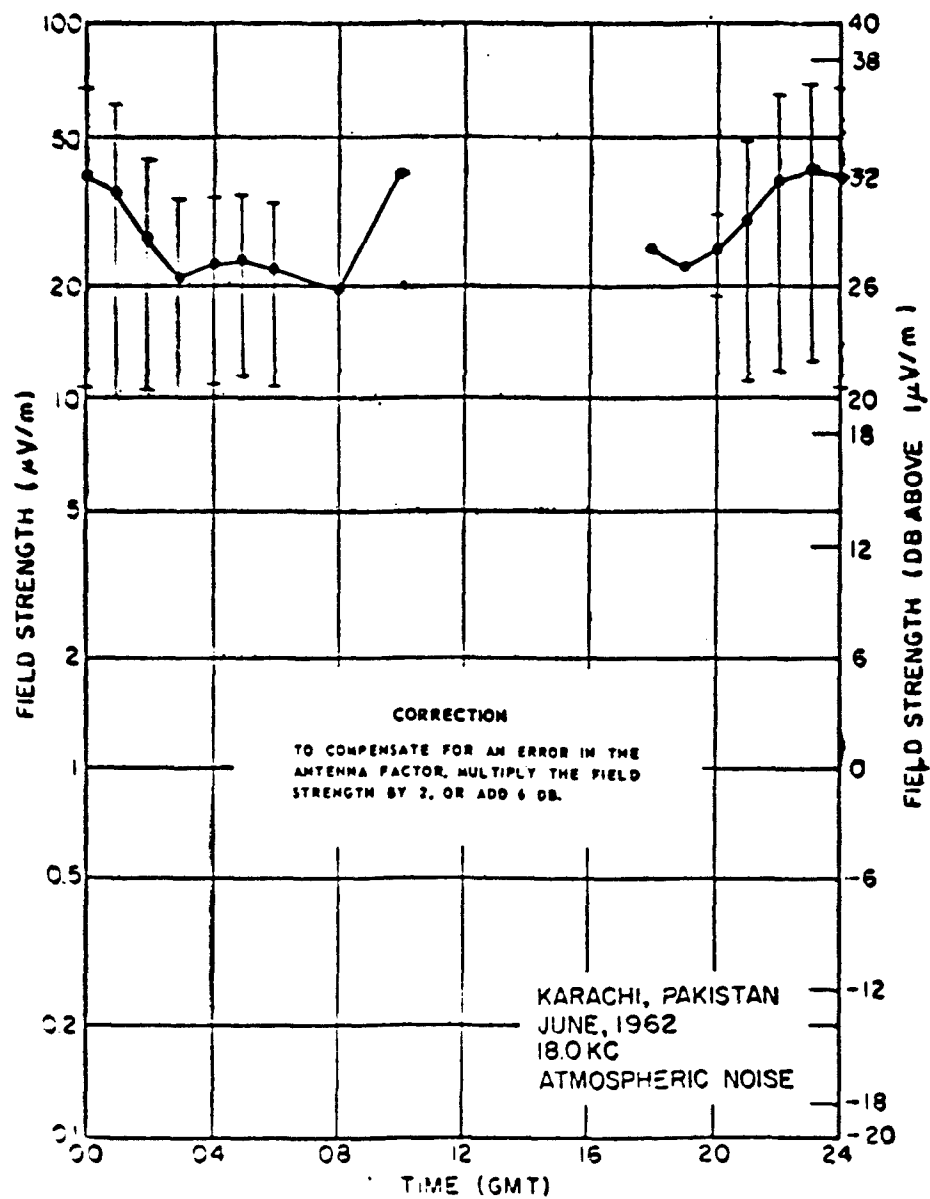


Figure 168

CONFIDENTIAL

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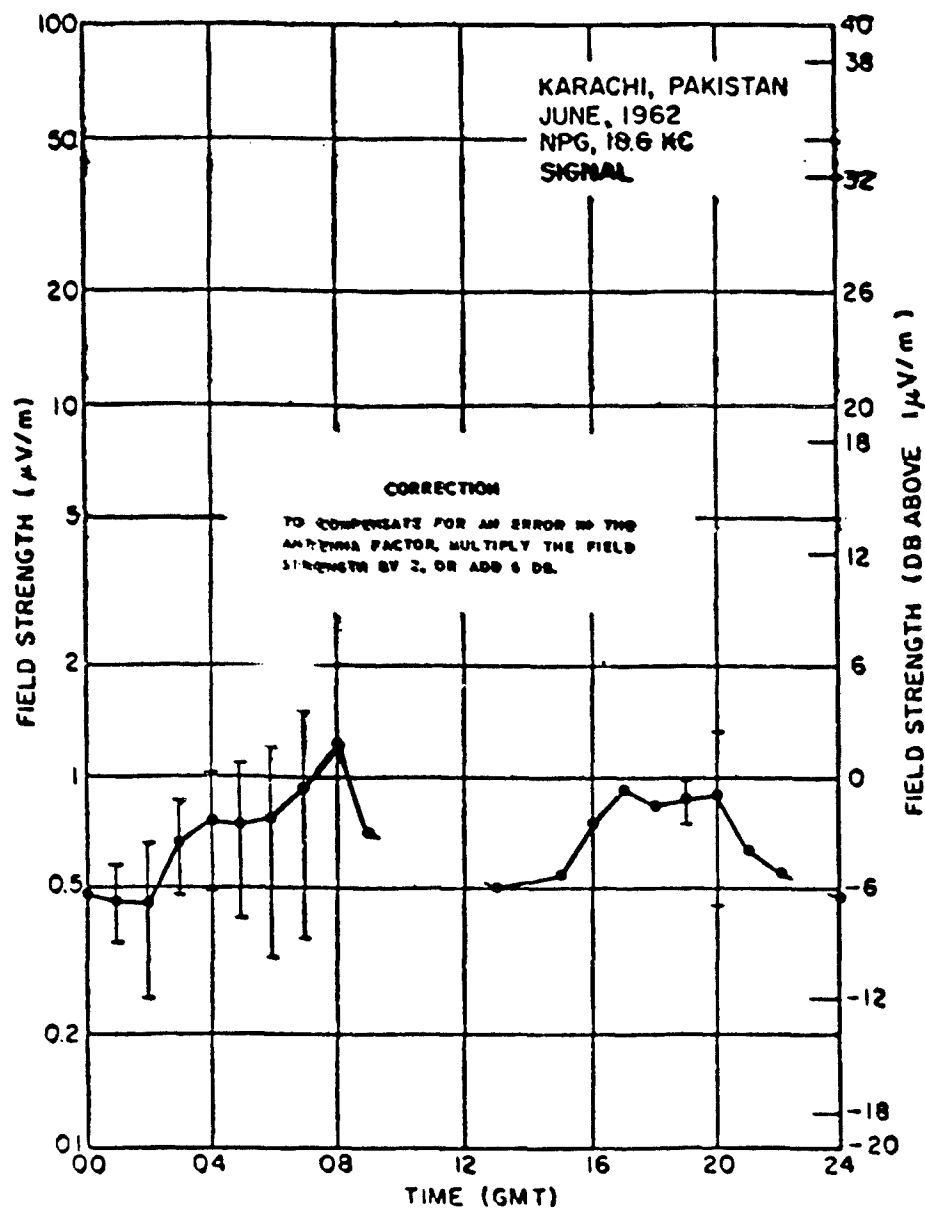


Figure 169

CONFIDENTIAL

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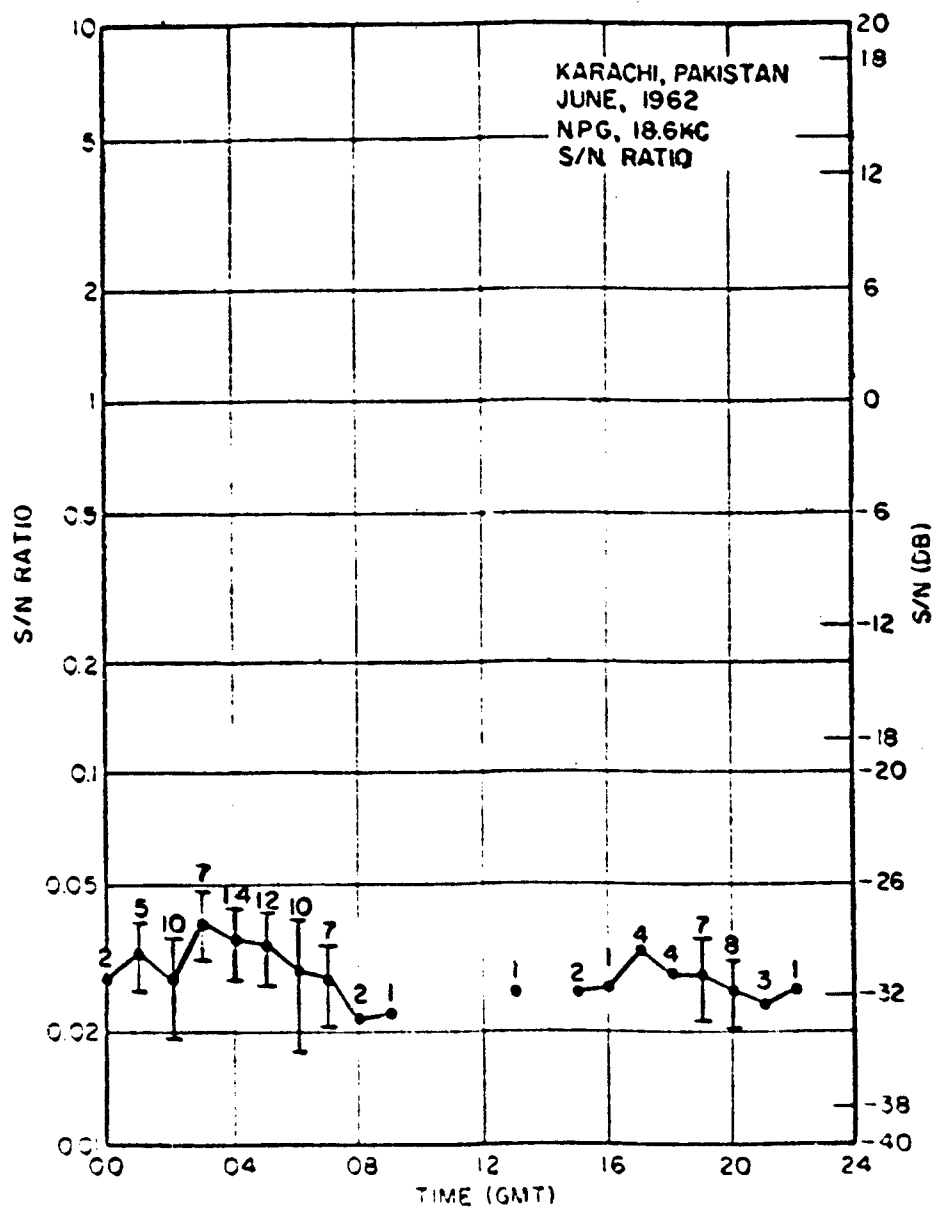


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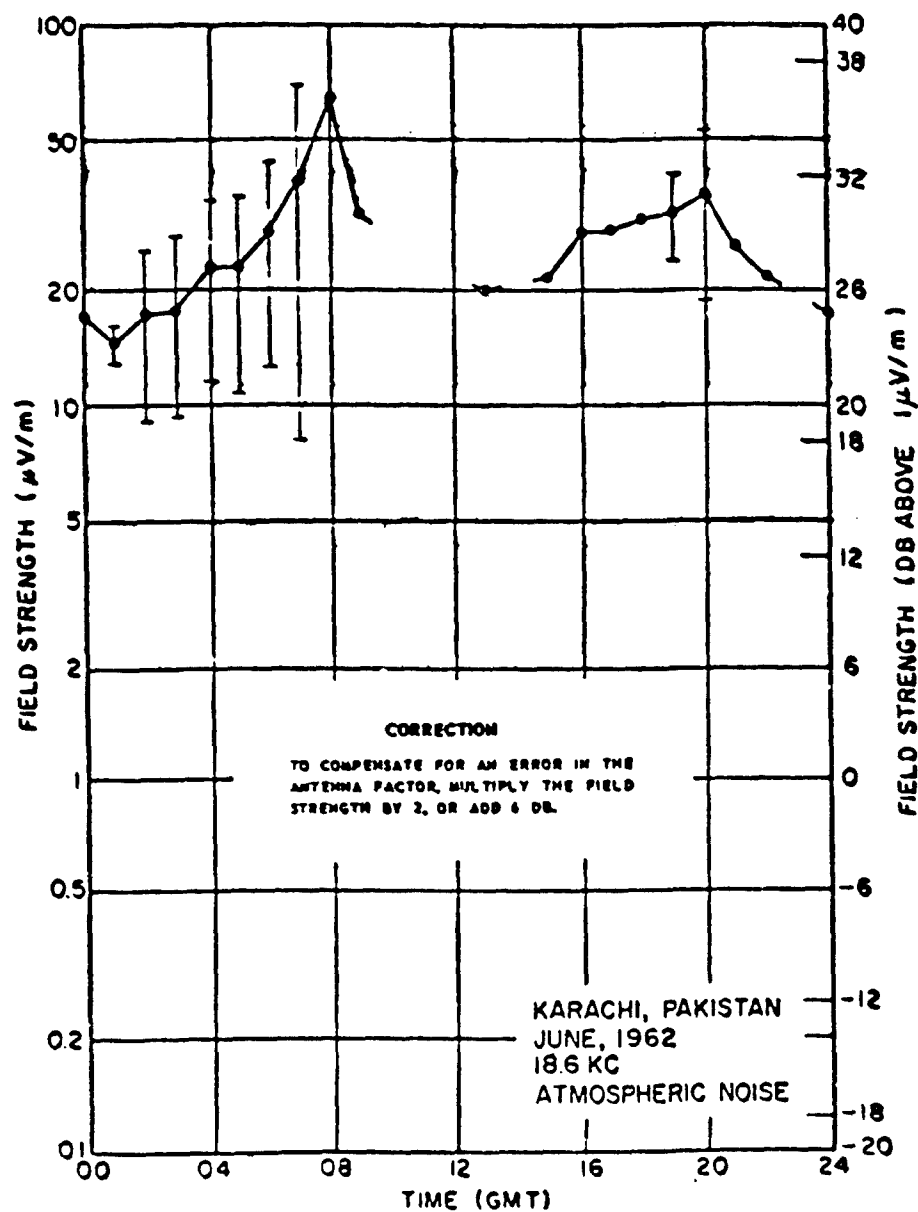


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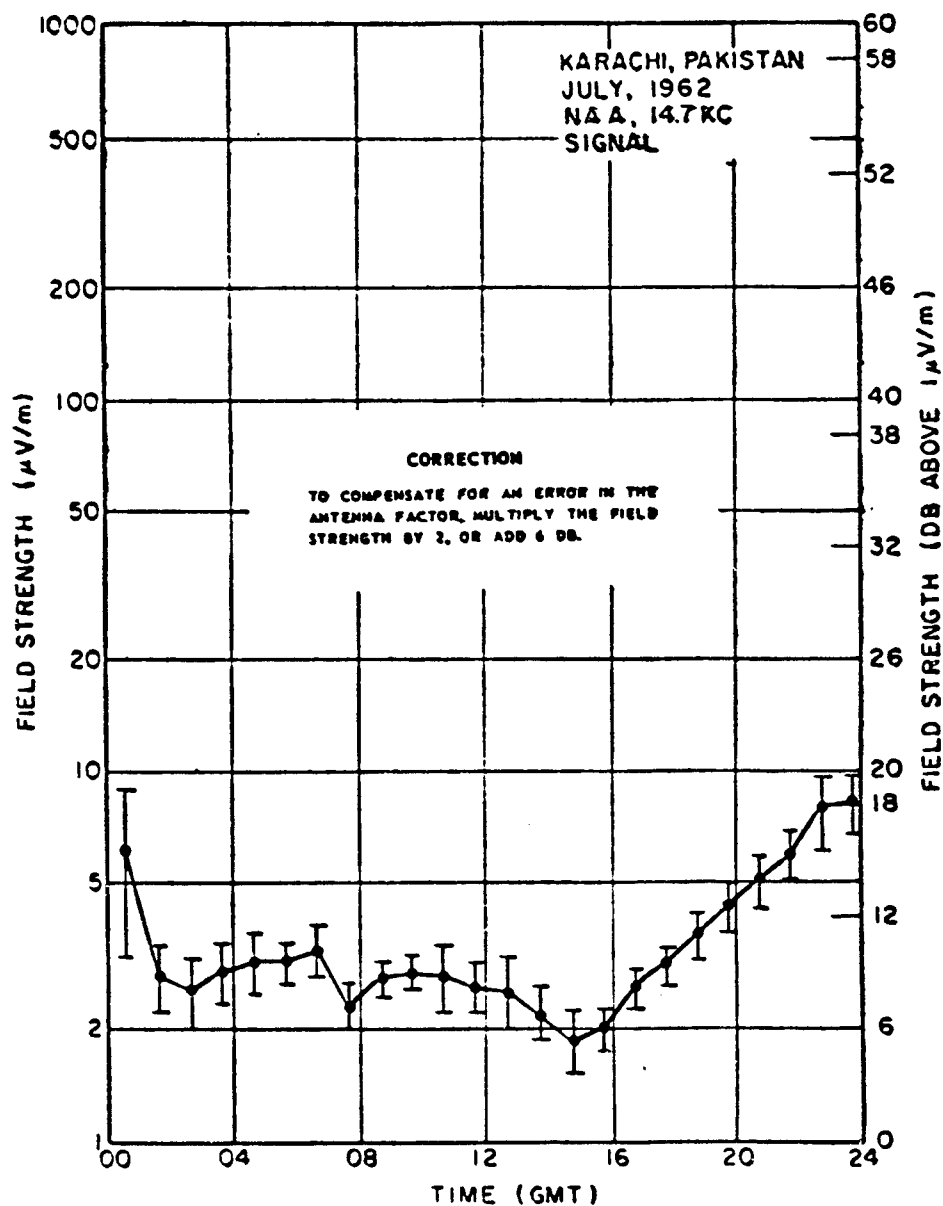


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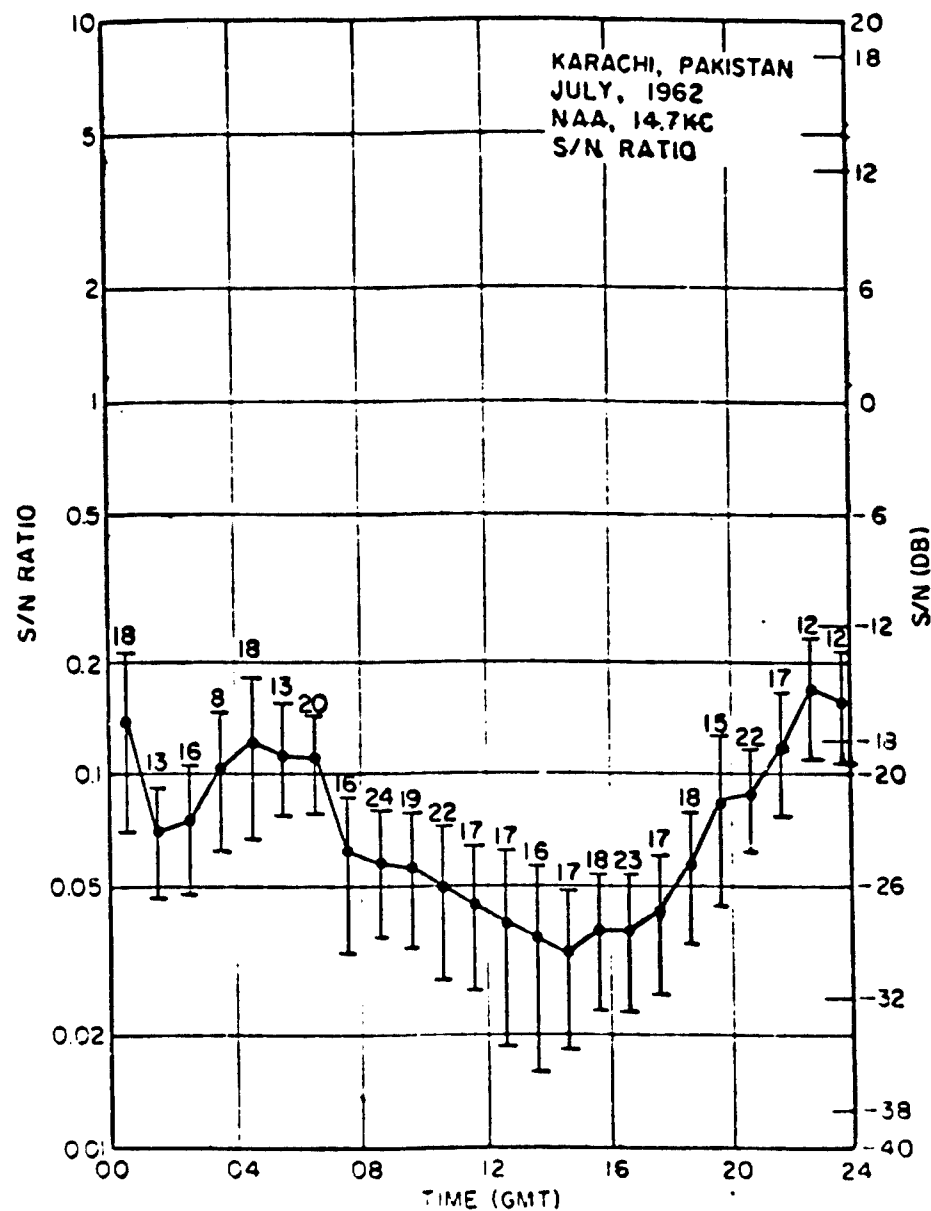


Figure 173

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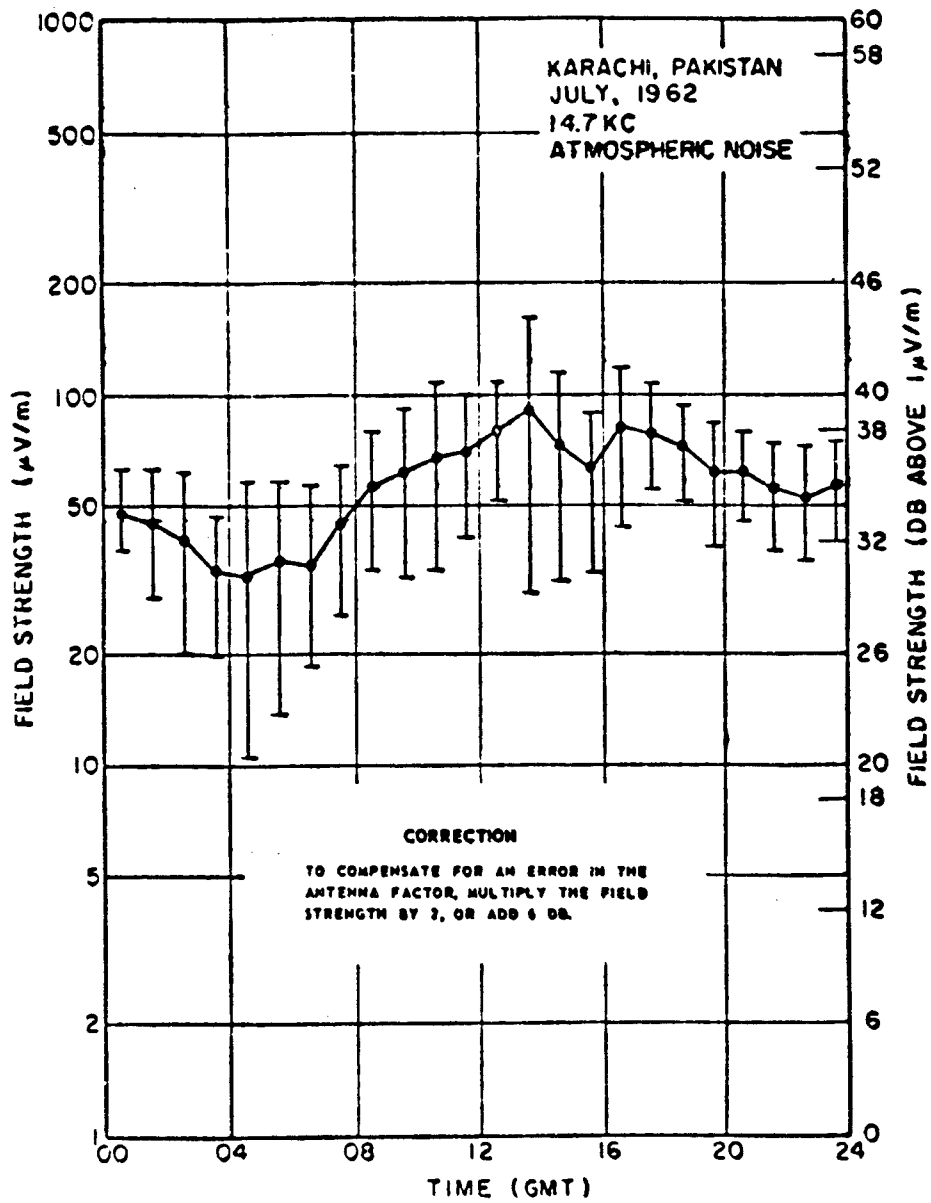


Figure 174

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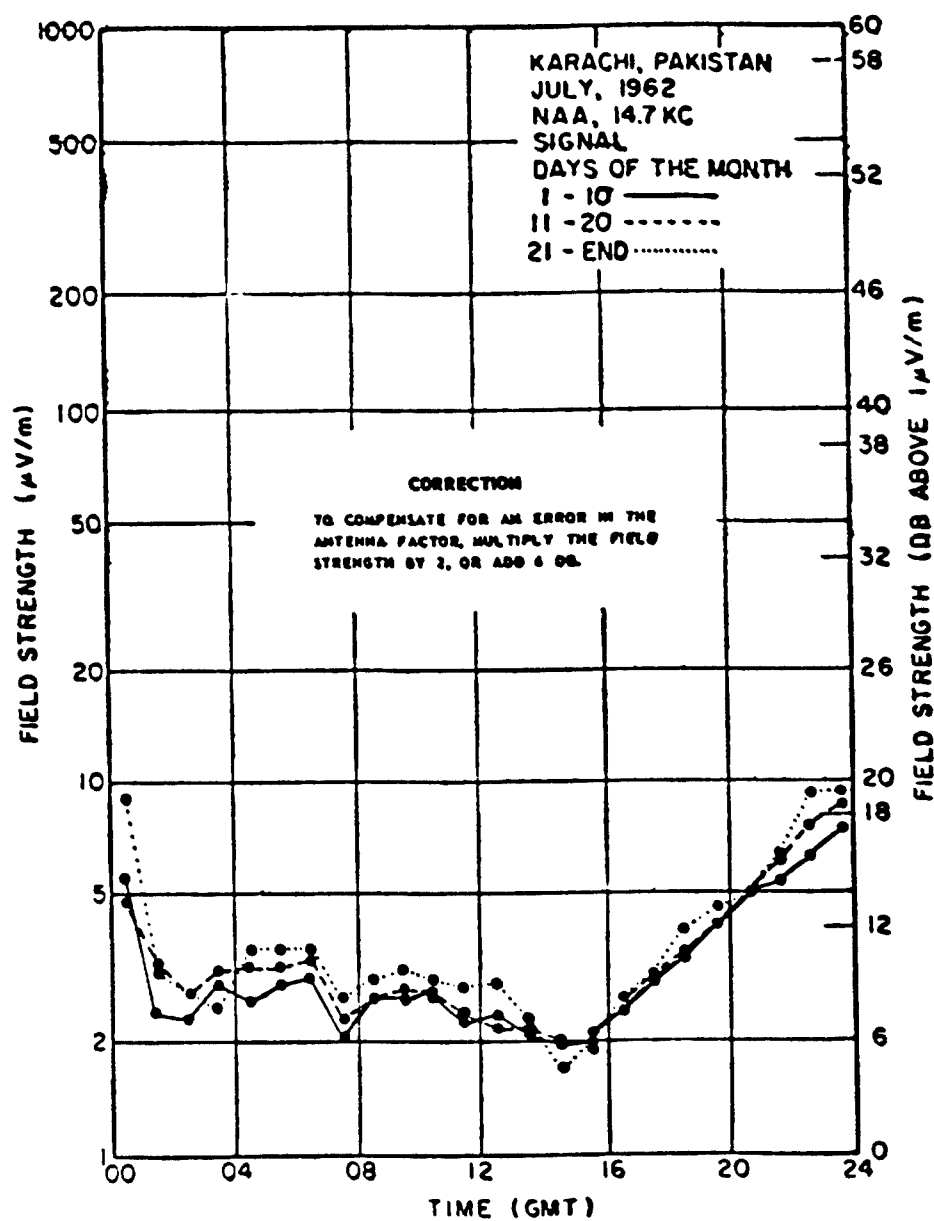


Figure 175

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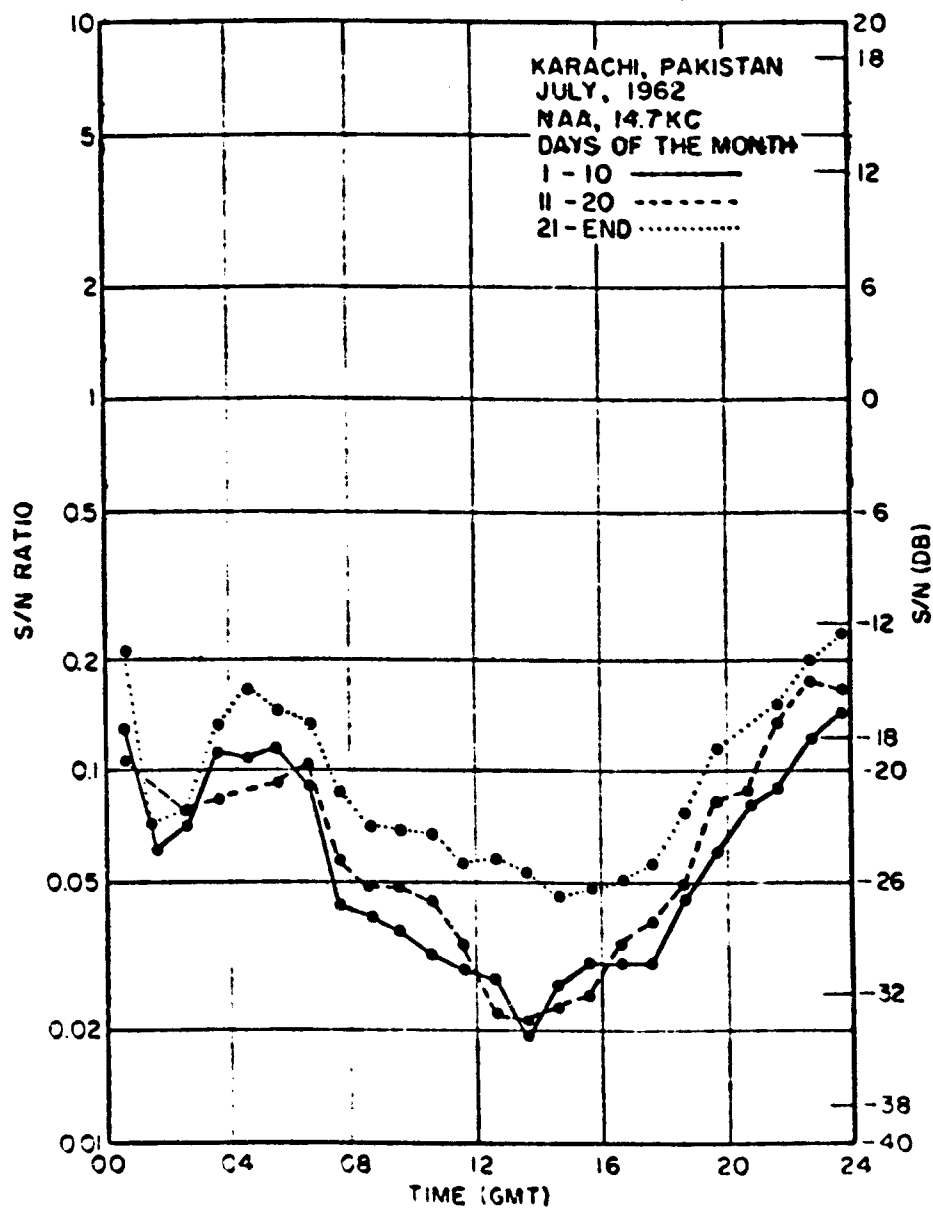


Figure 176

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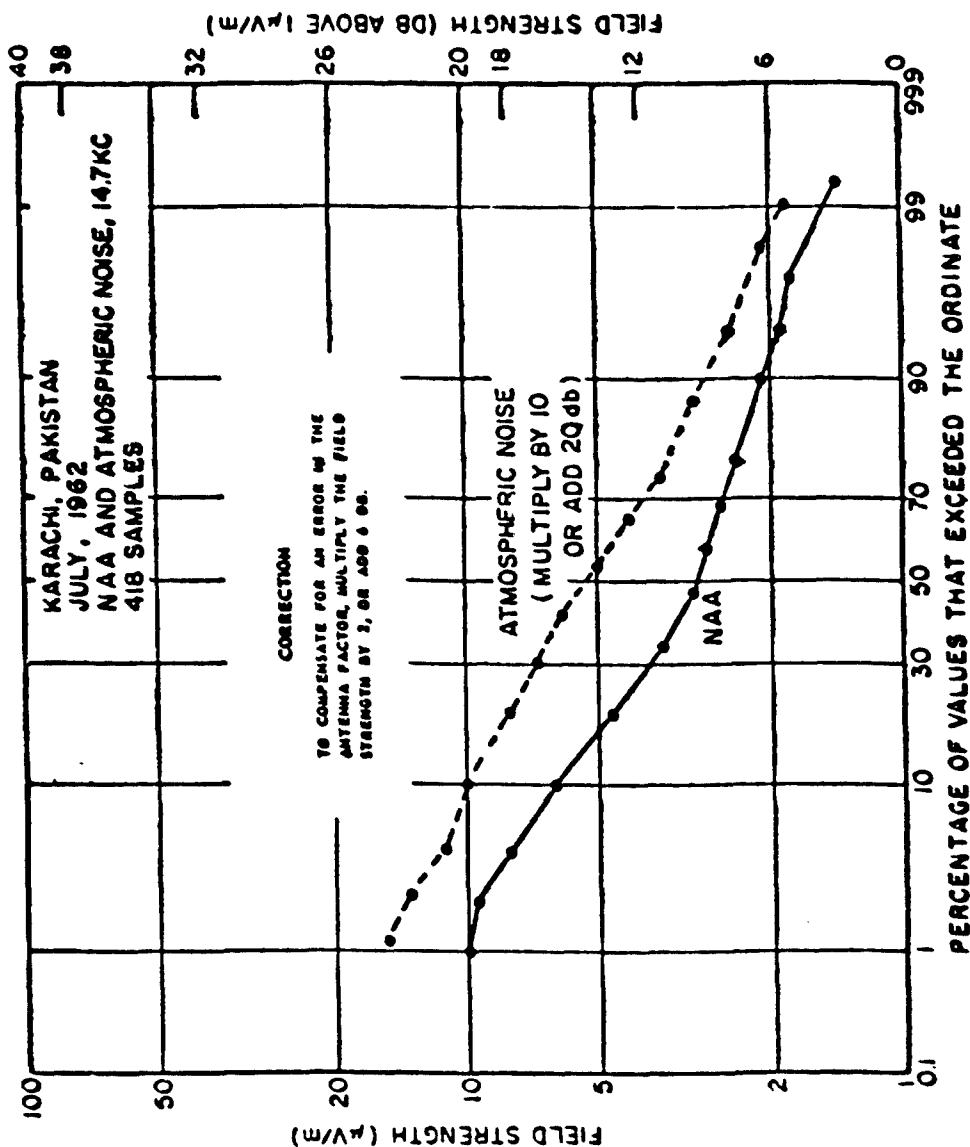


Figure 177

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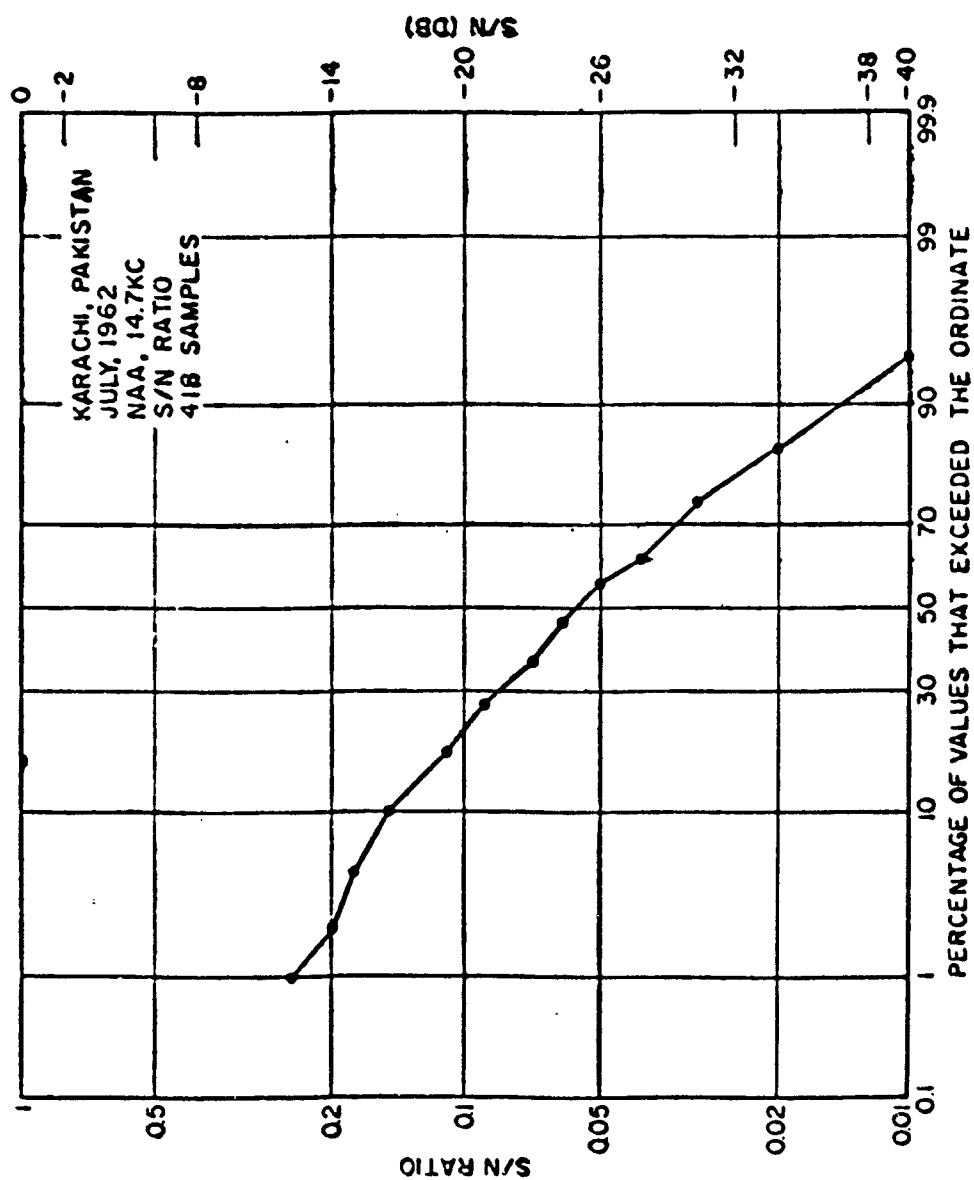


Figure 178

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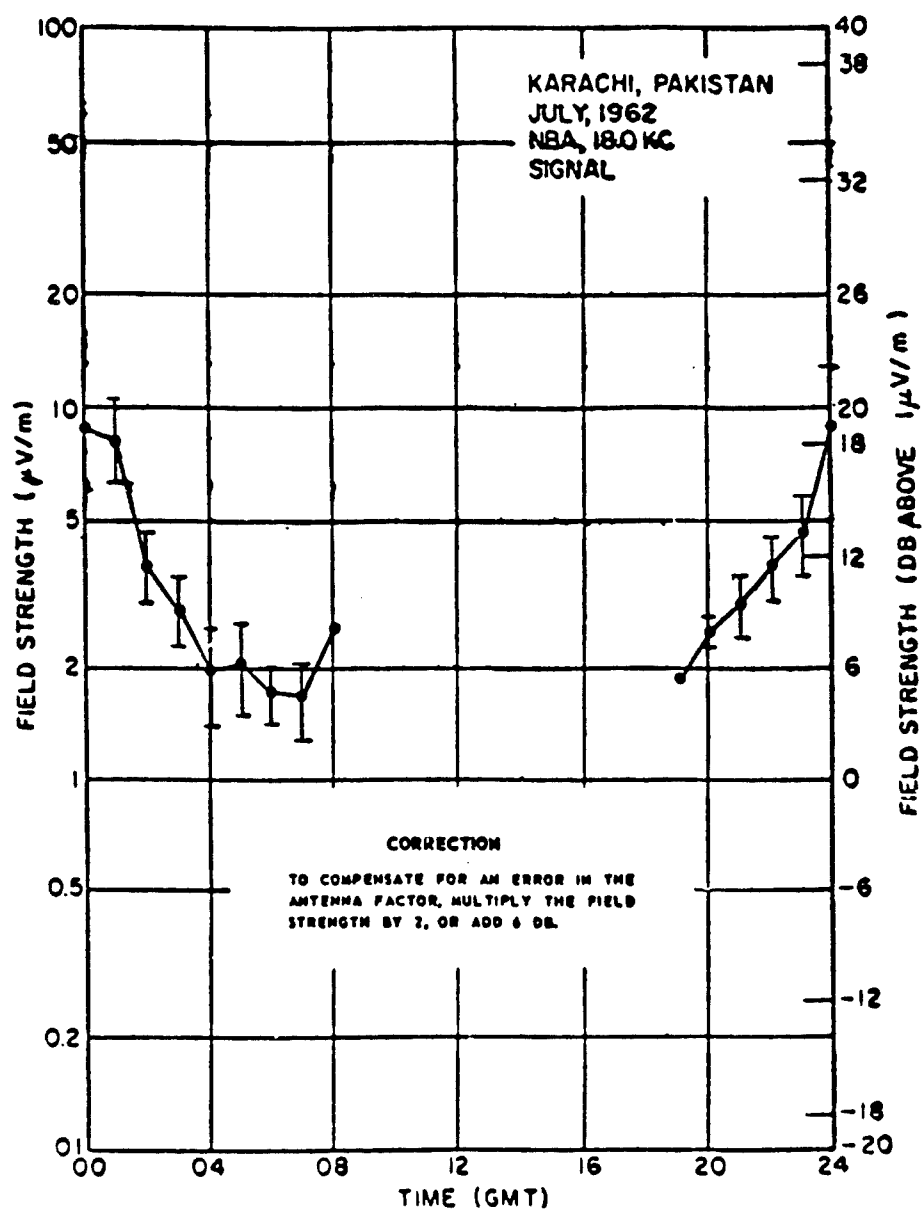


Figure 179

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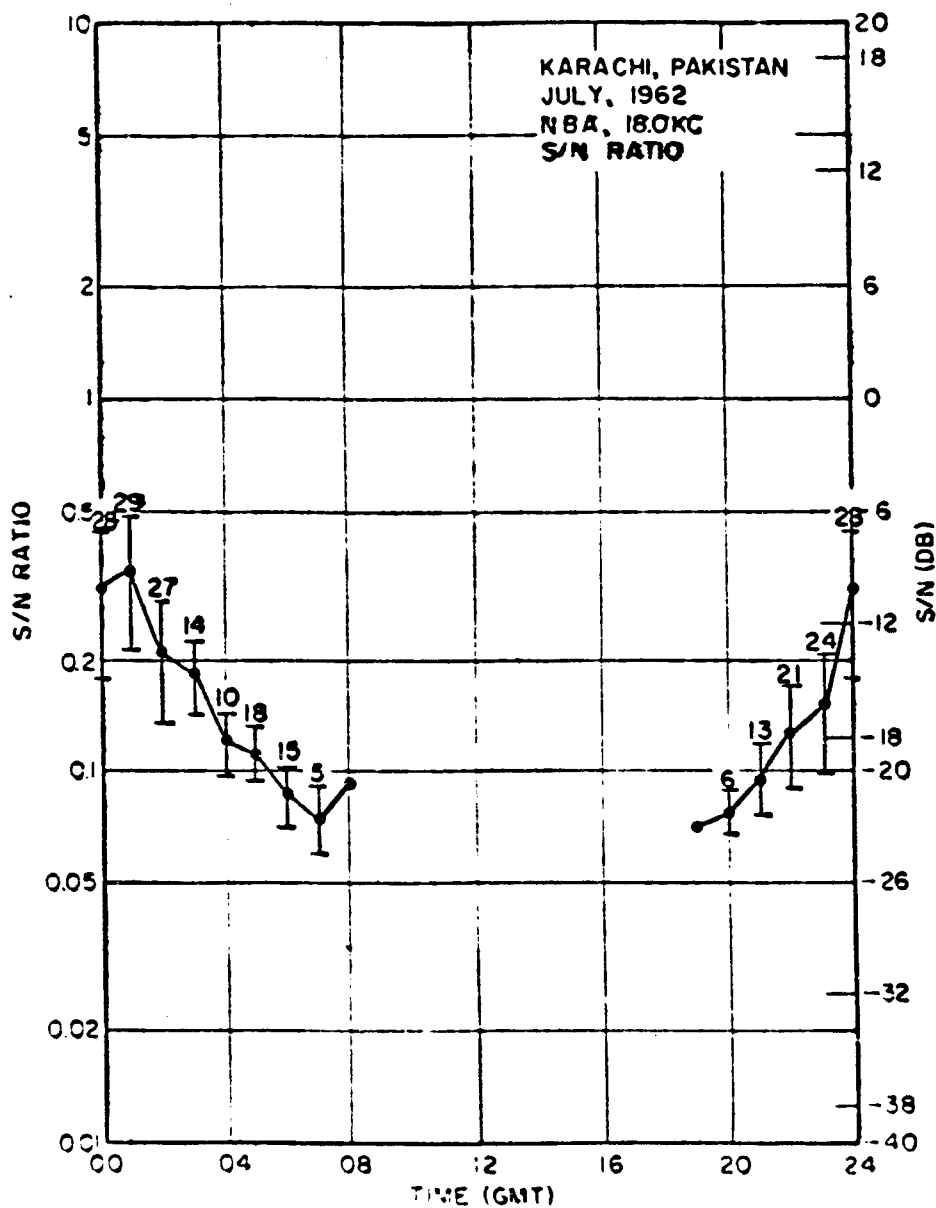


Figure 180

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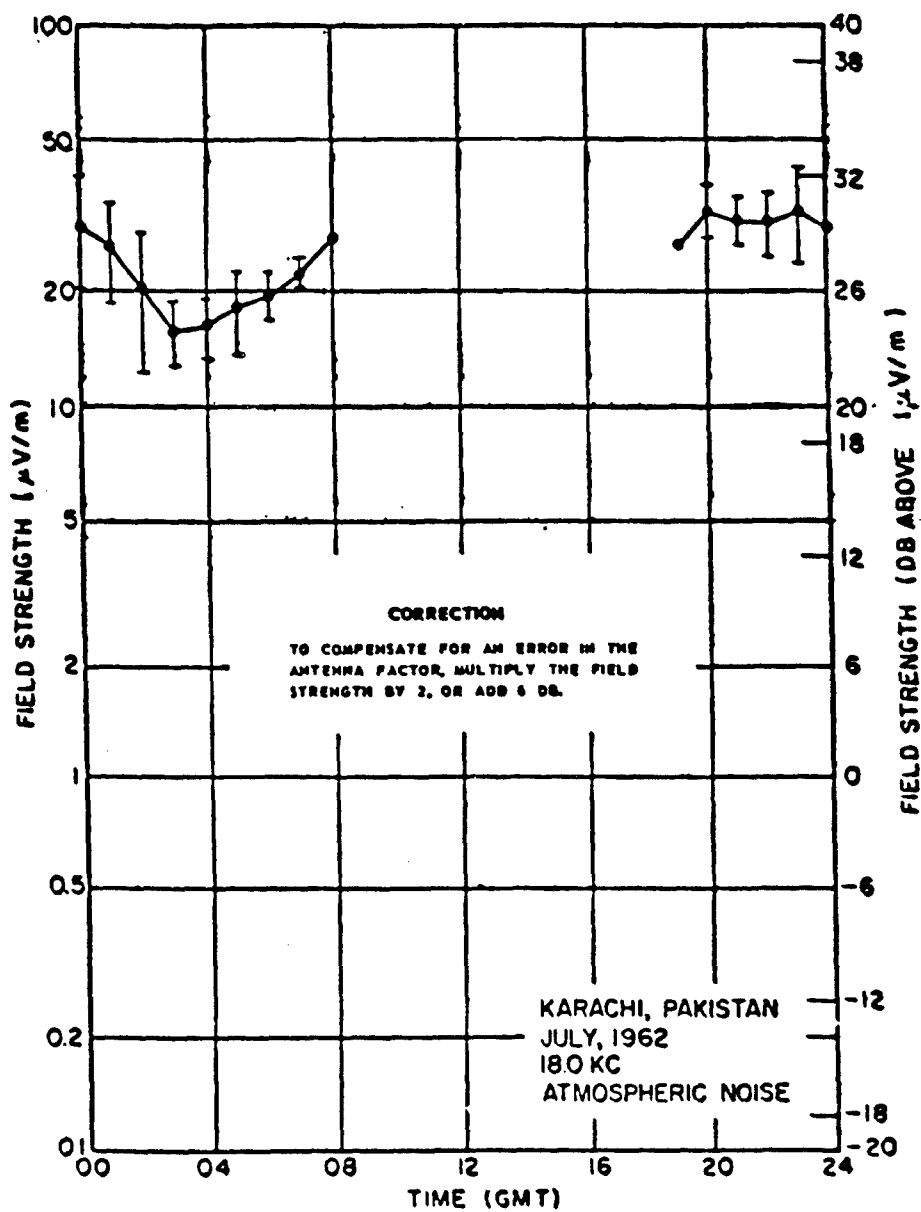


Figure 181

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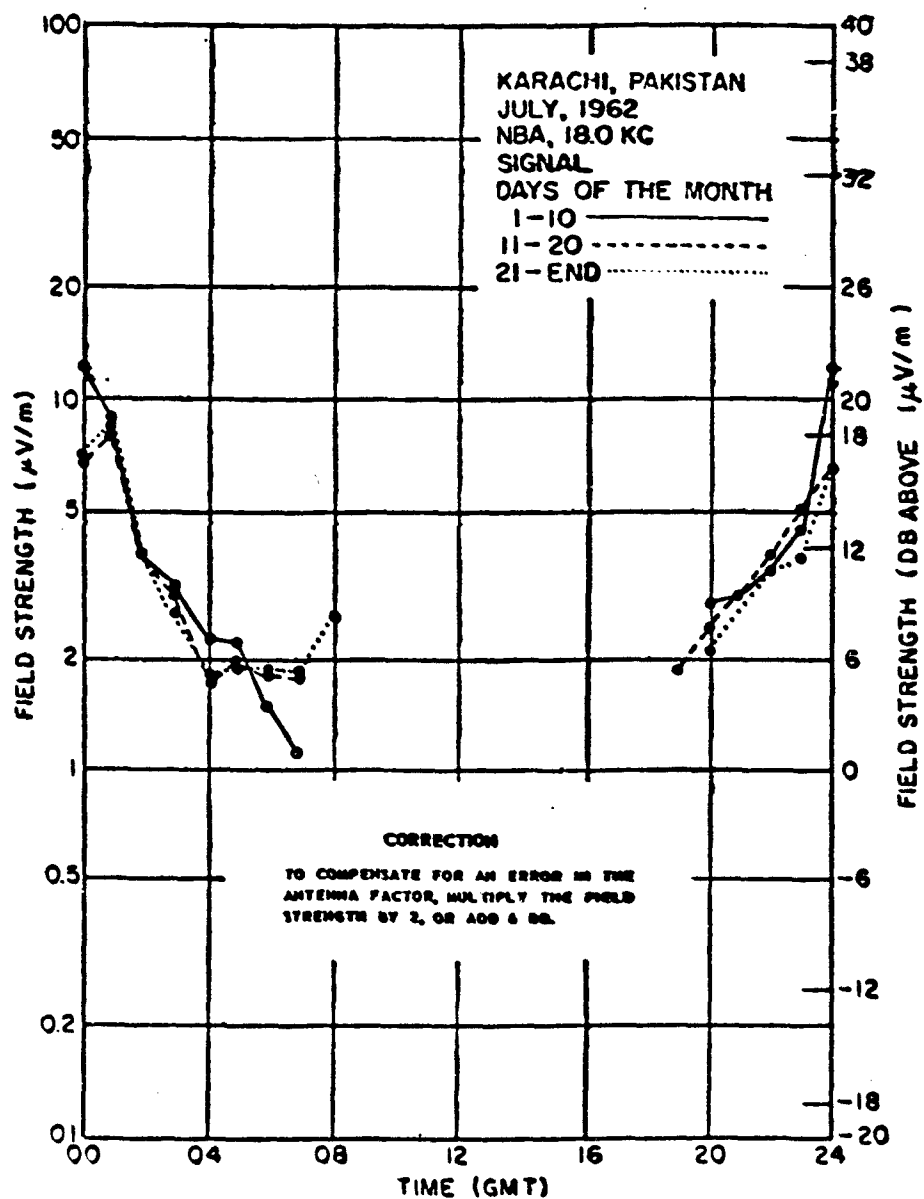


Figure 182

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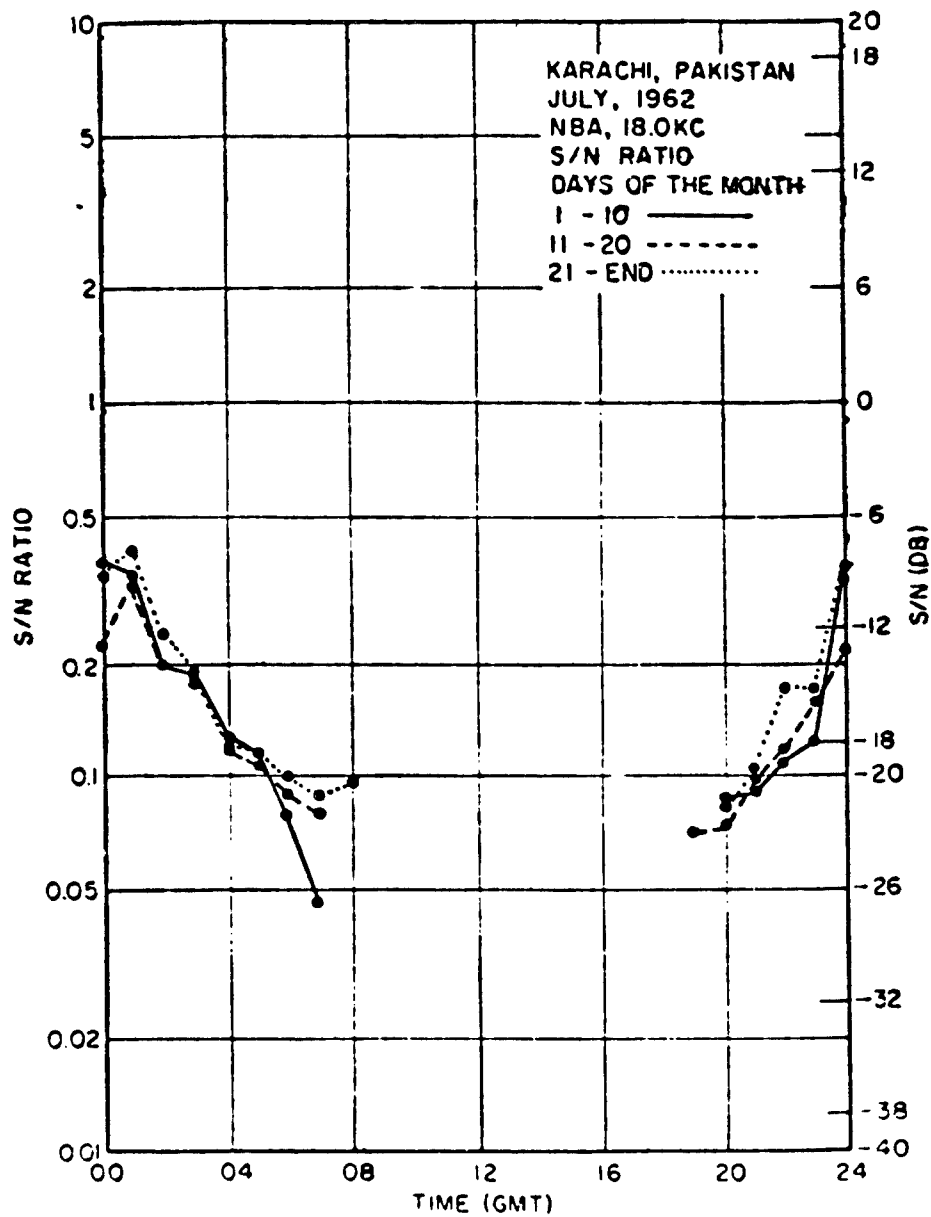


Figure 183

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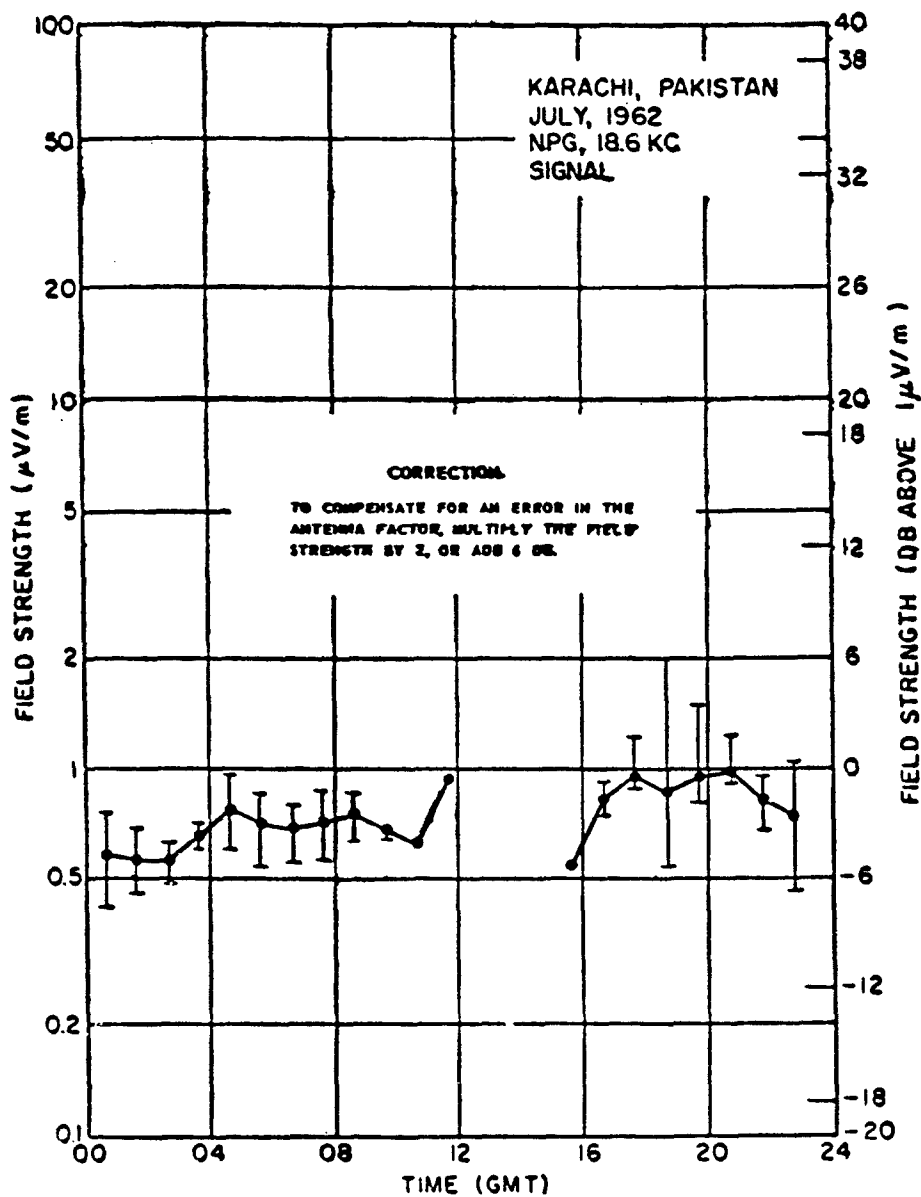


Figure 184

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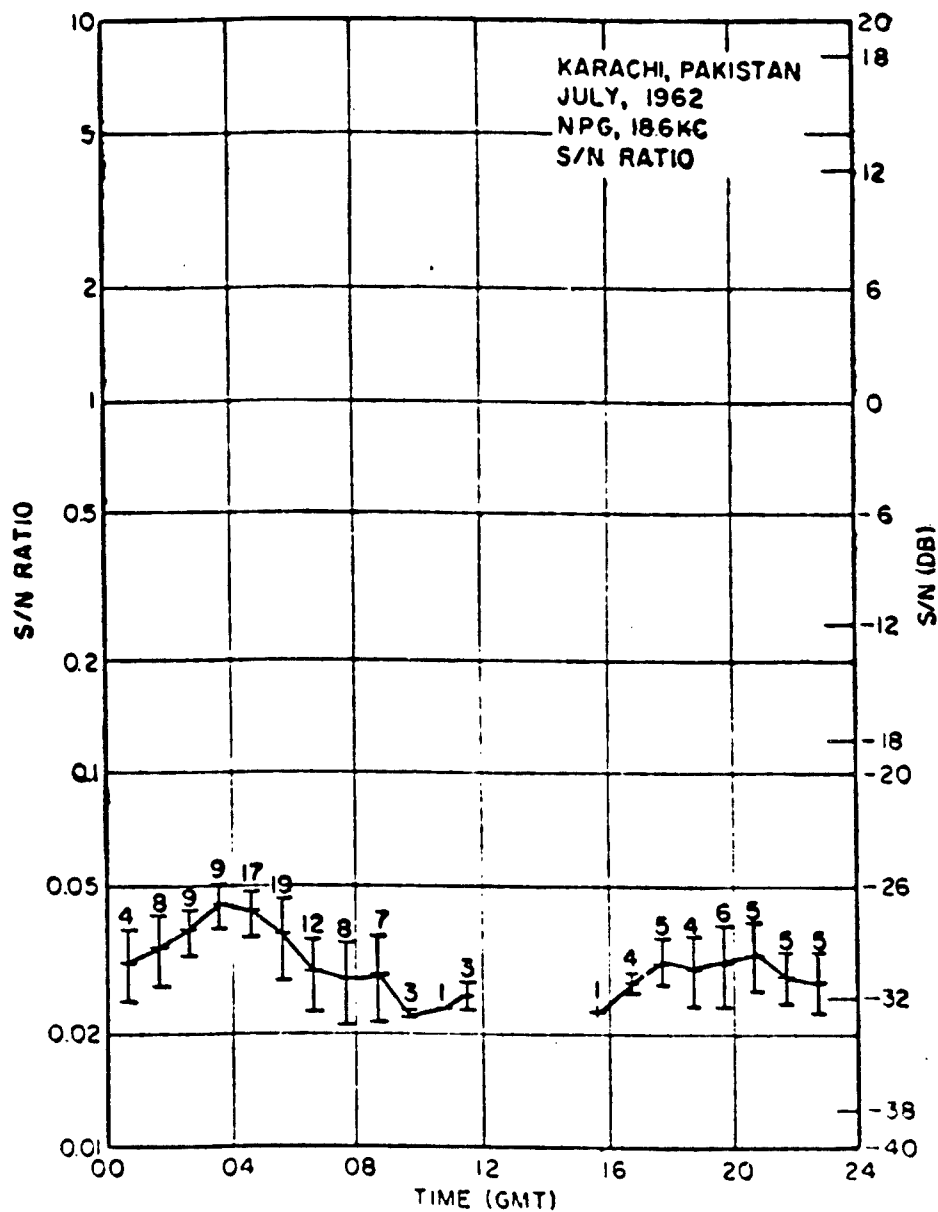


Figure 185

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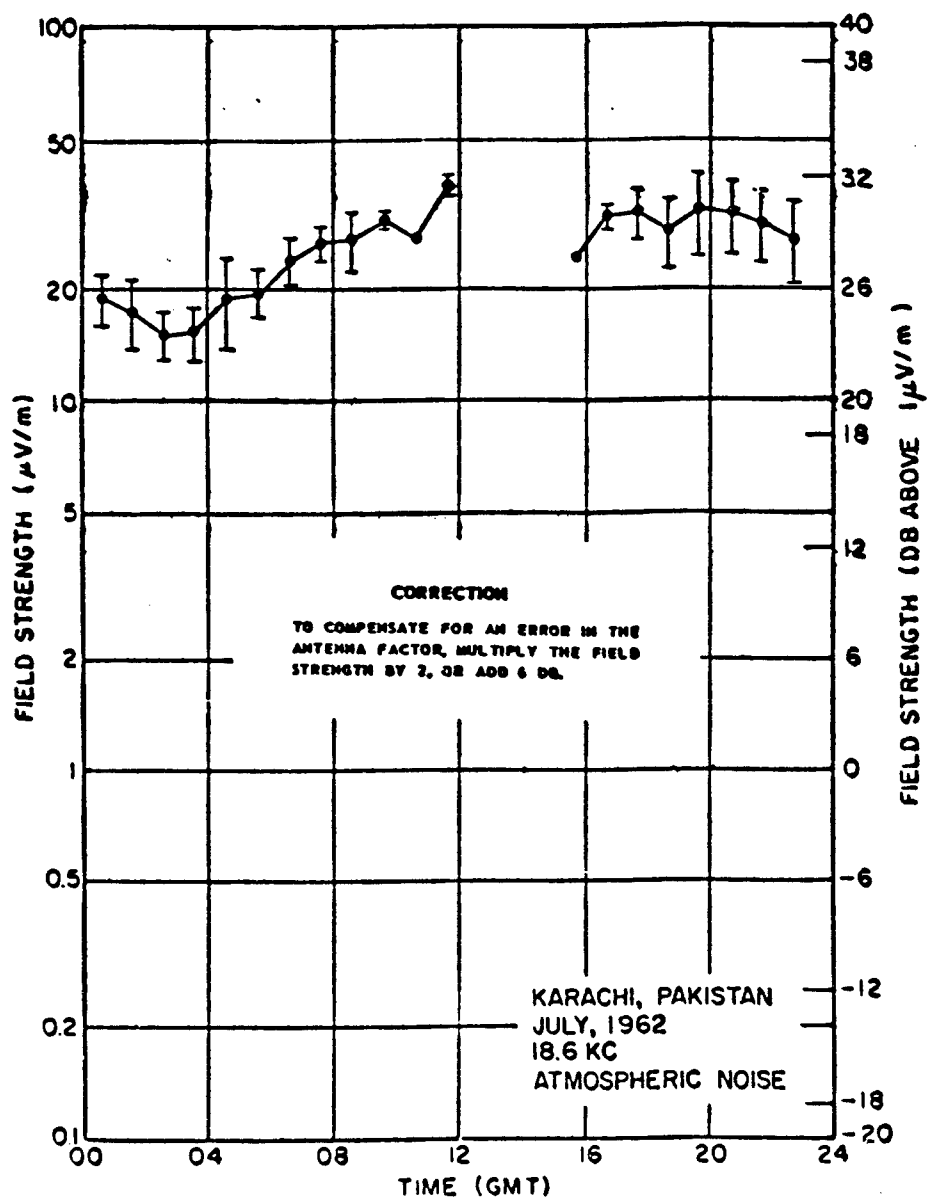


Figure 186

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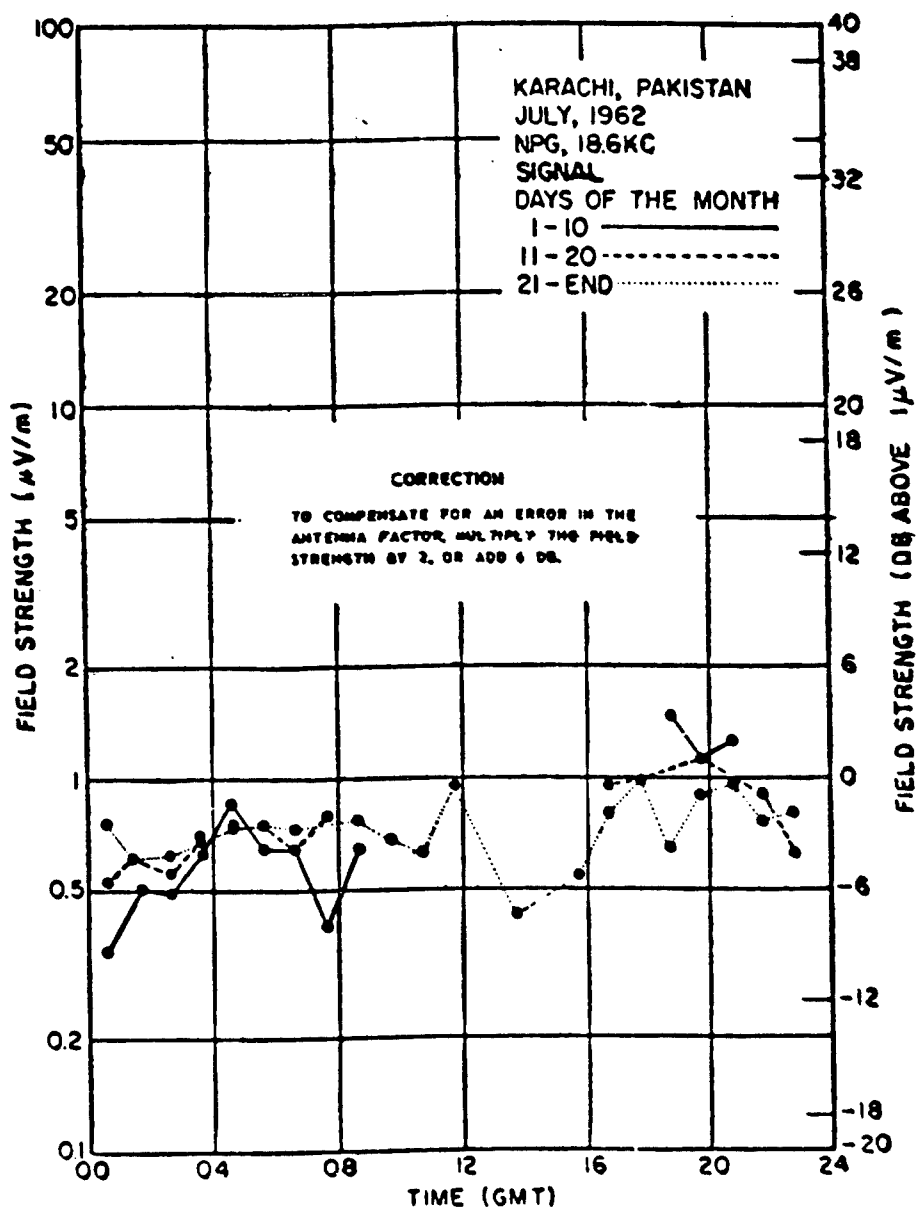


Figure 187

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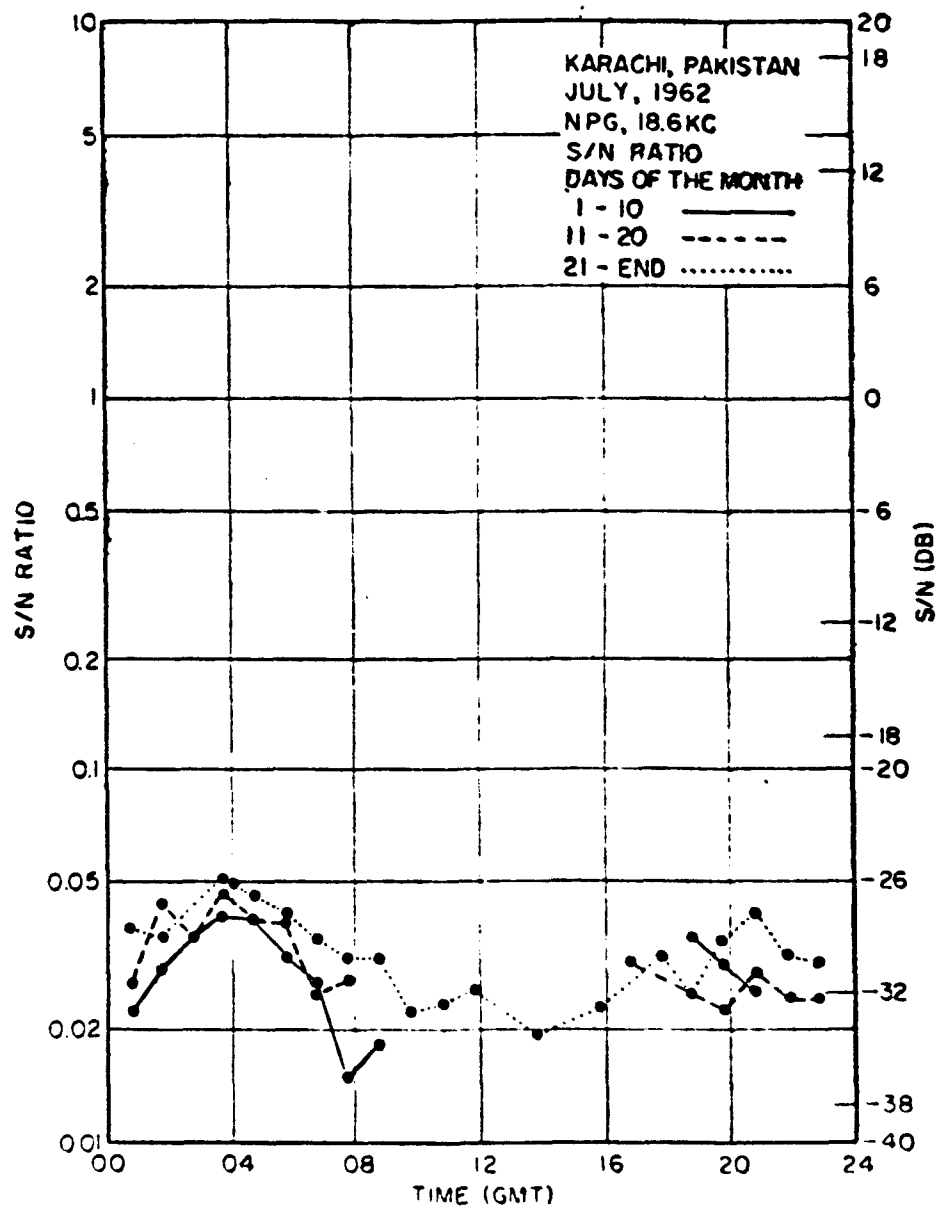


Figure 188

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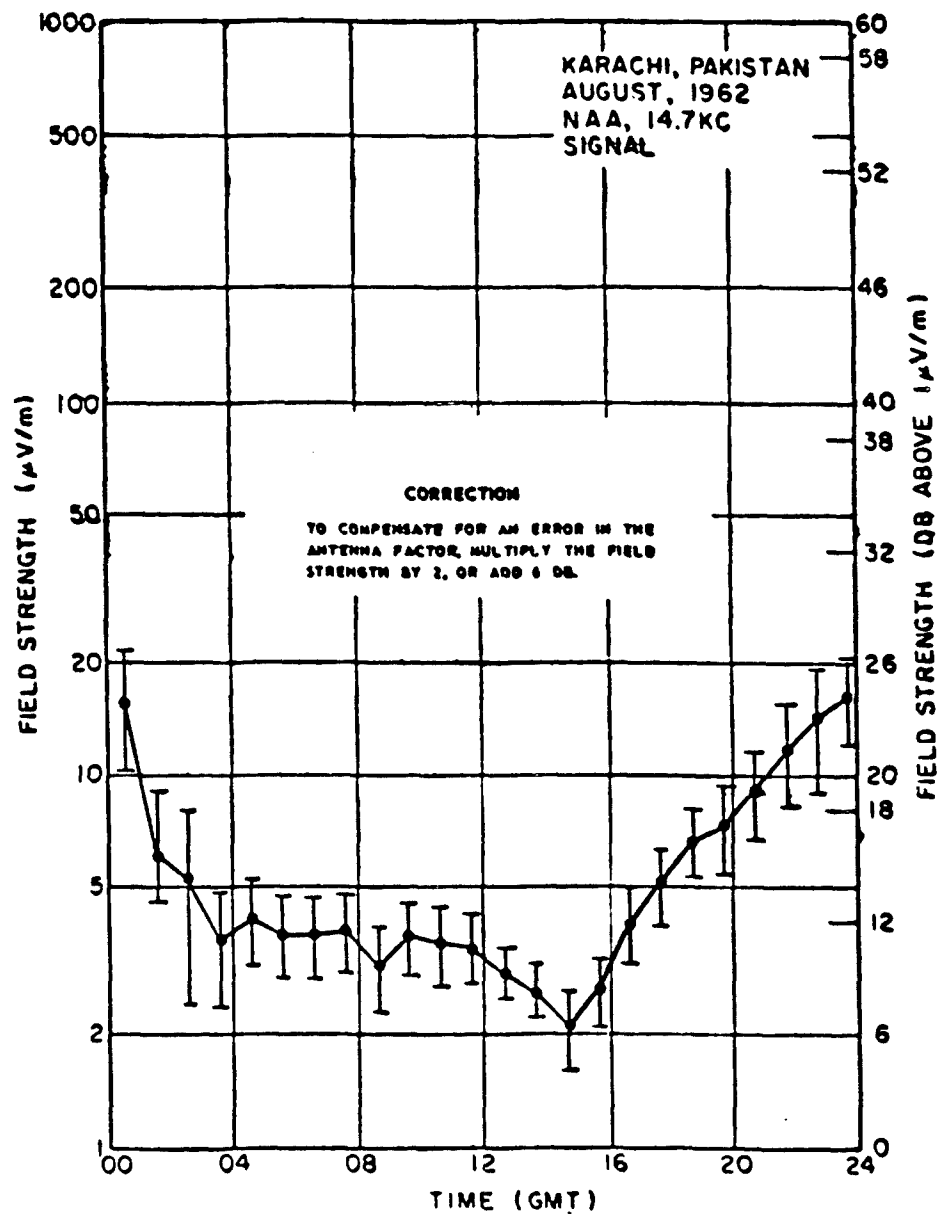


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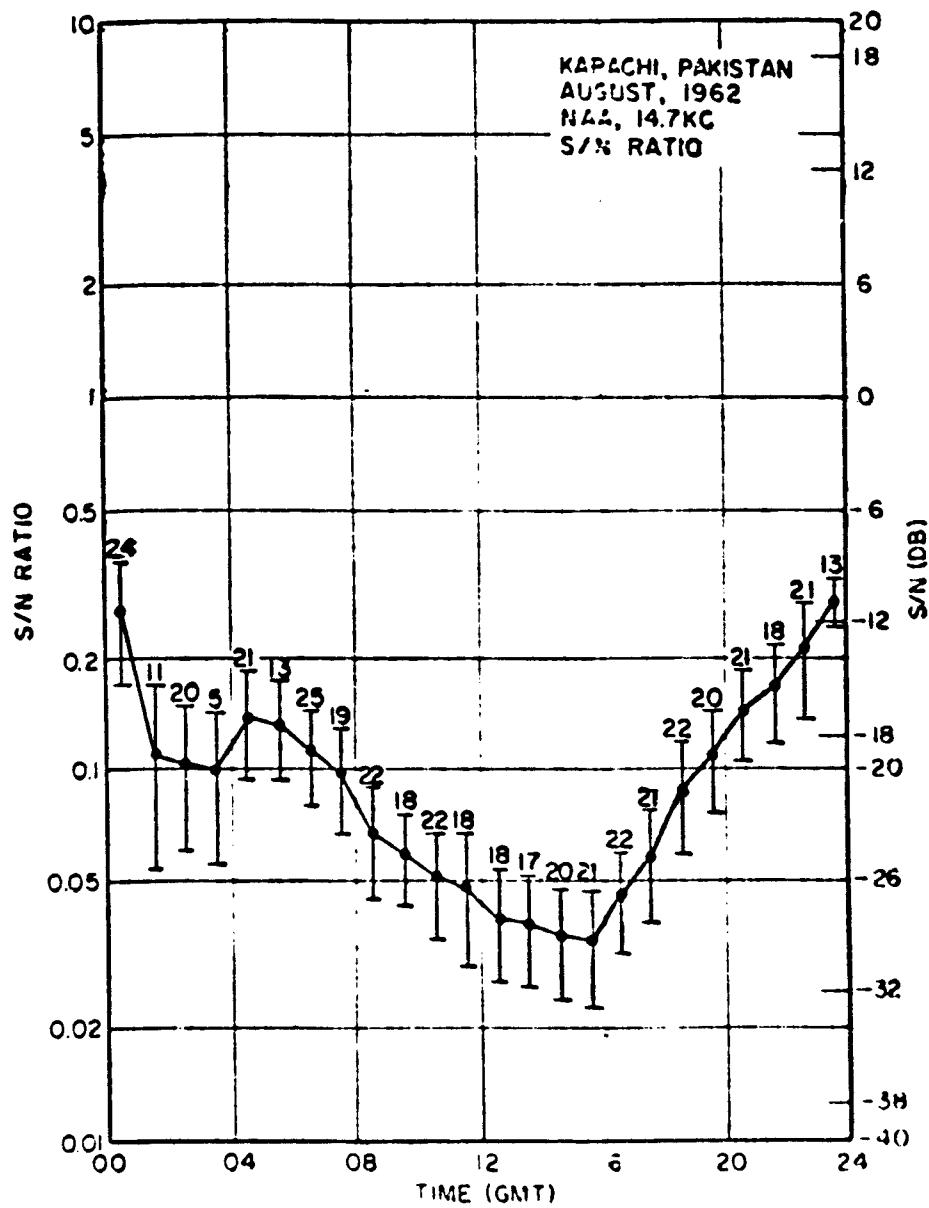


Figure 190

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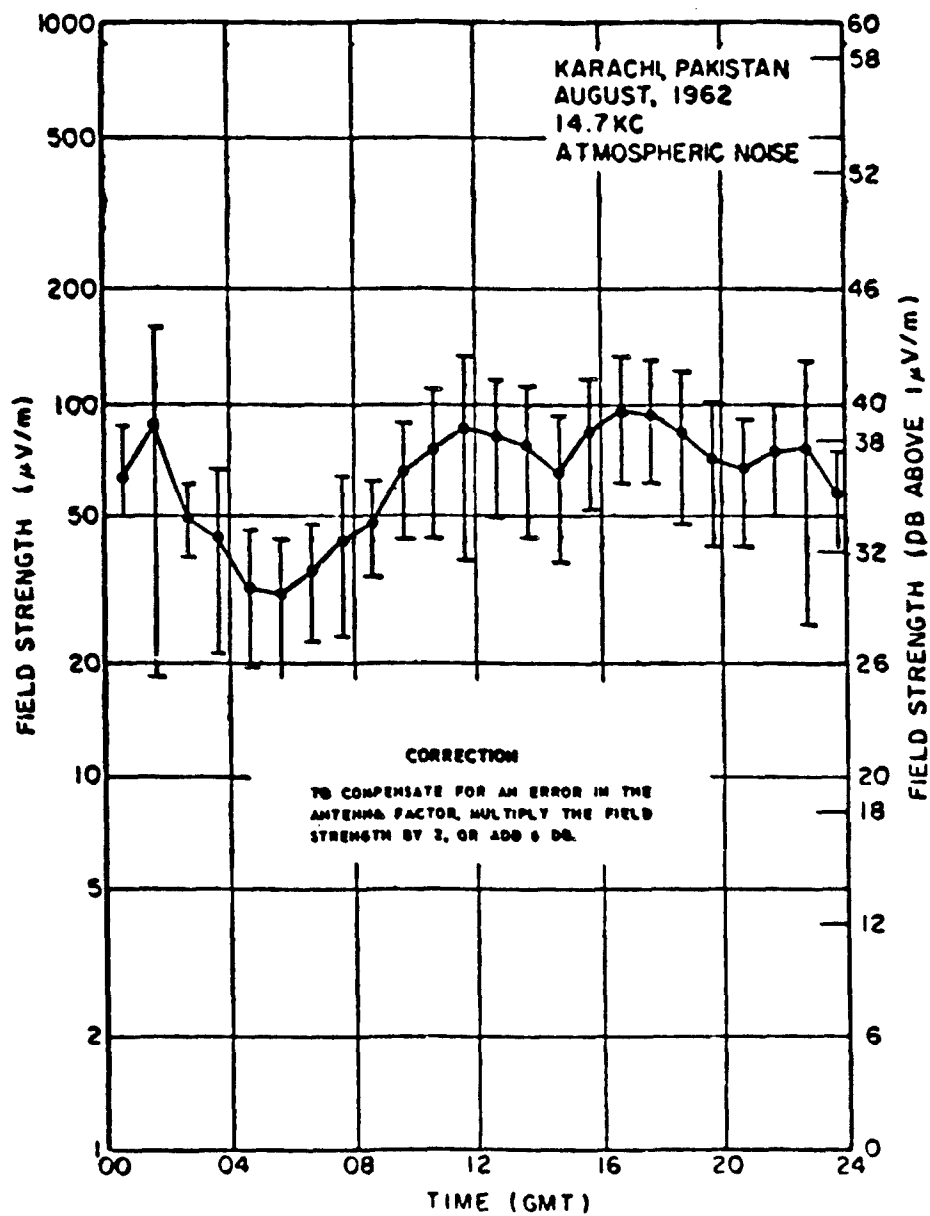


Figure 191

CONFIDENTIAL

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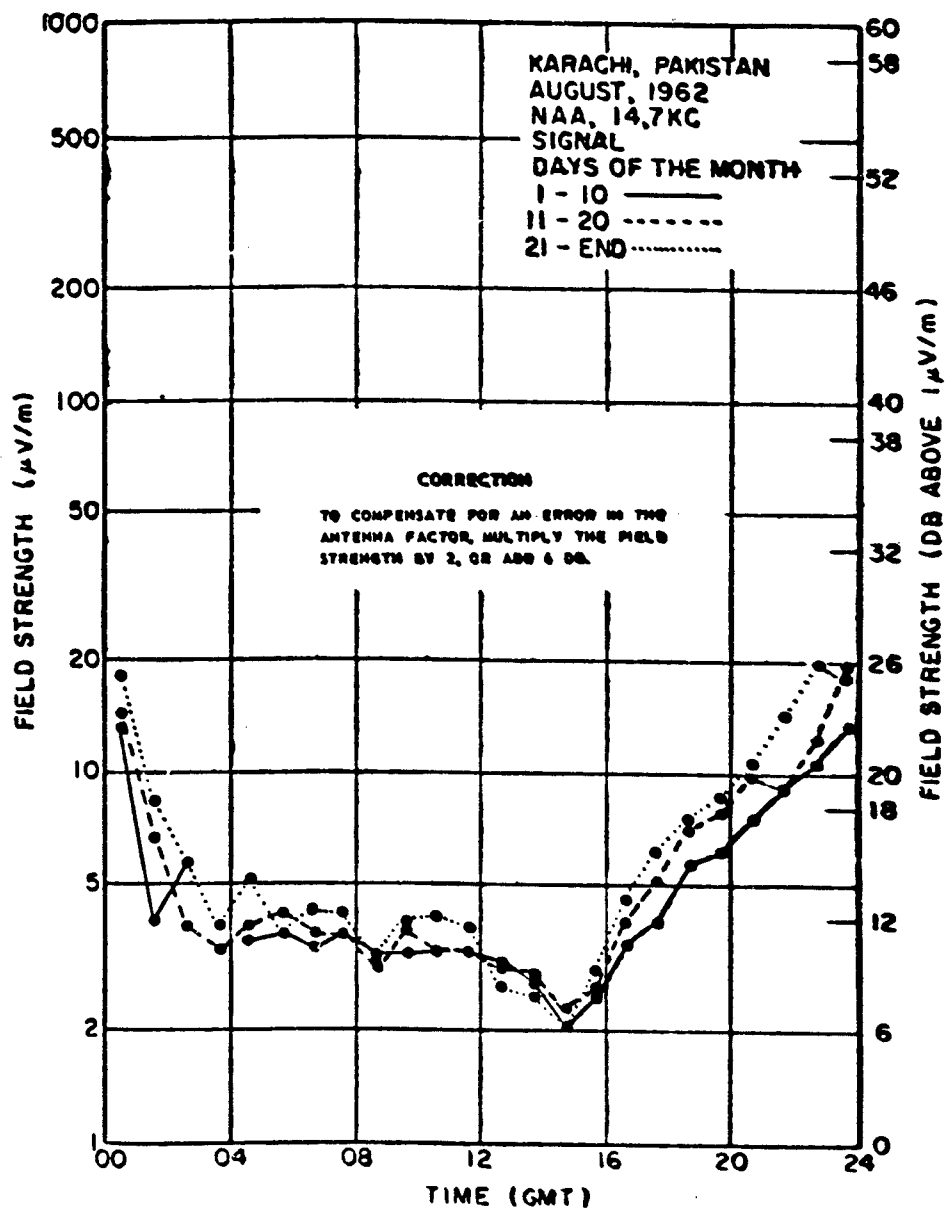


Figure 192

CONFIDENTIAL

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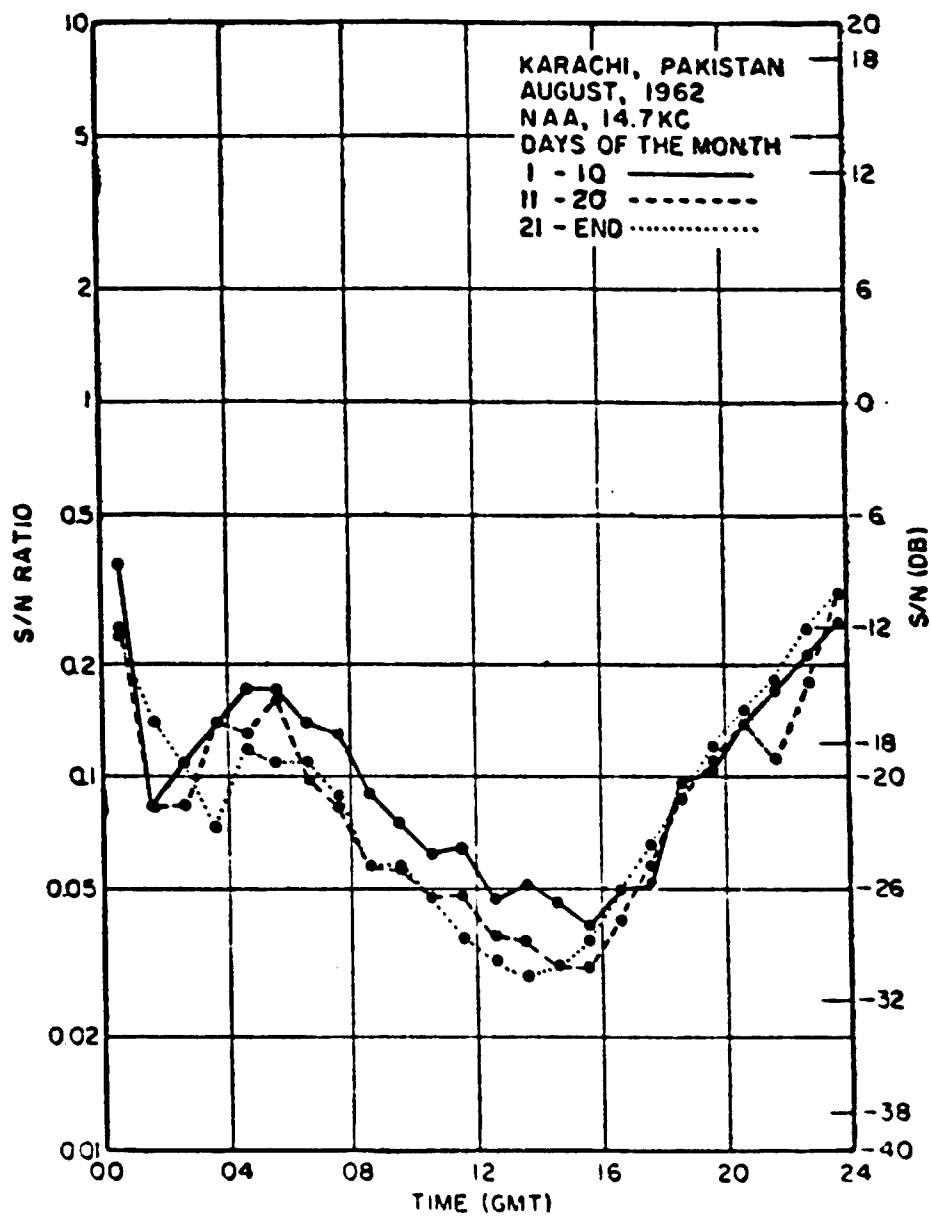


Figure 193

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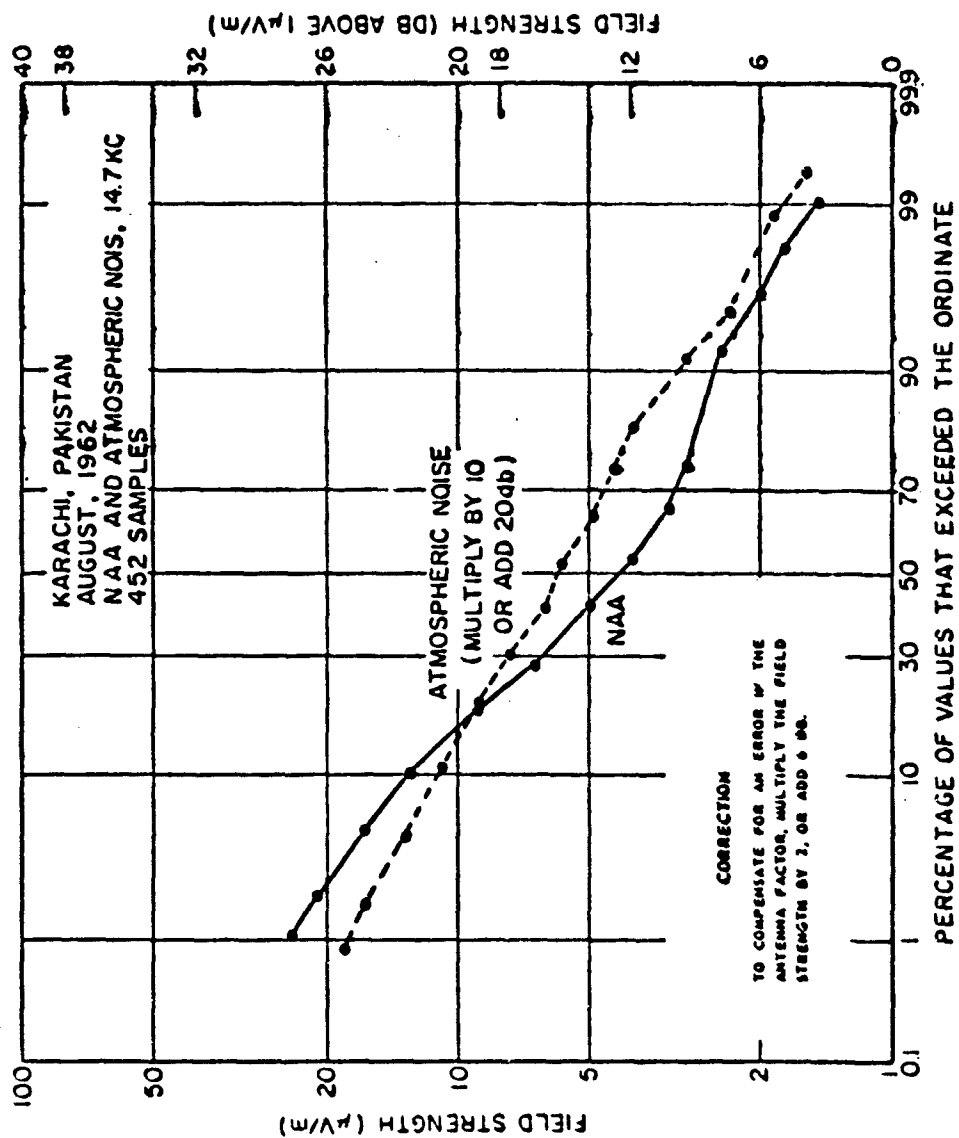


Figure 194

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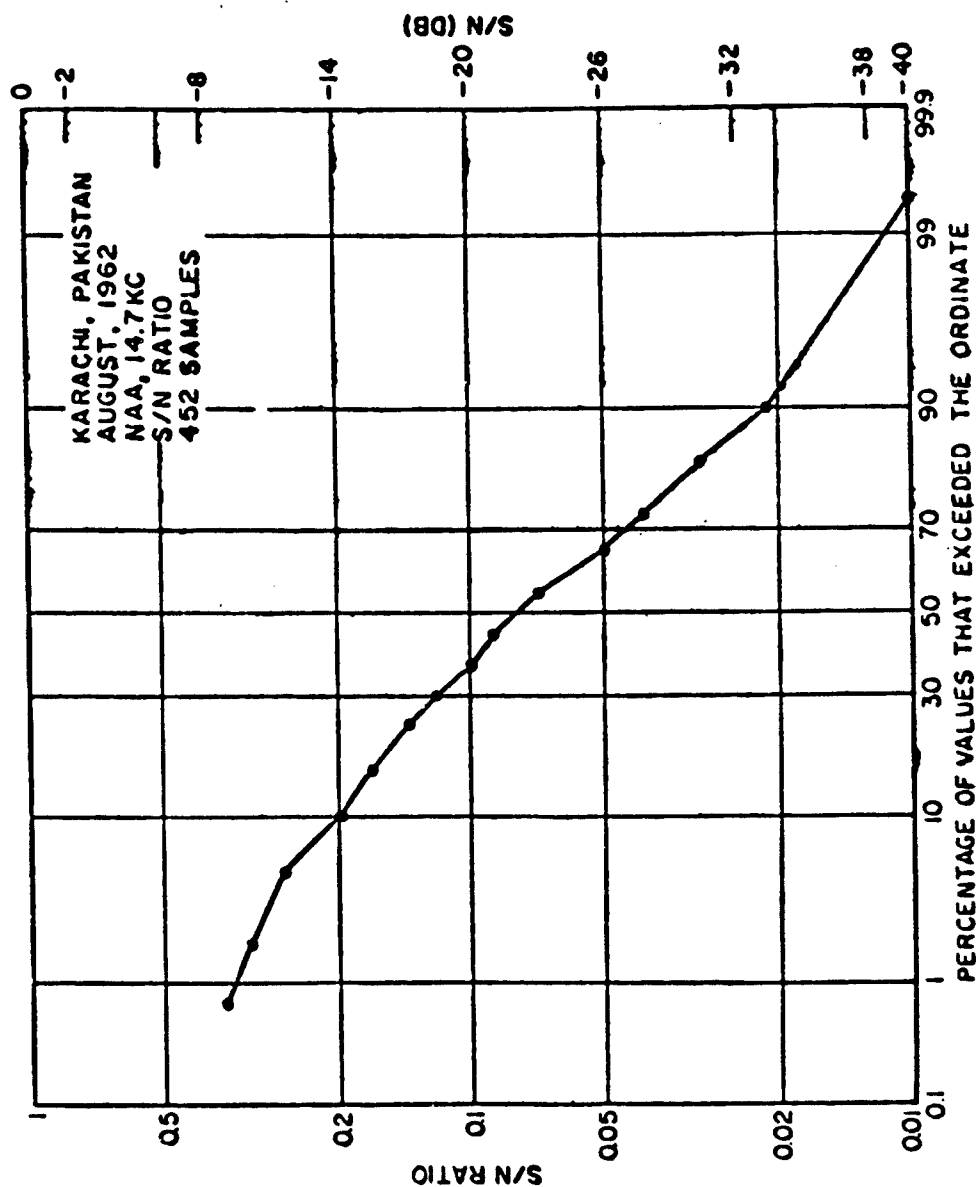


Figure 165

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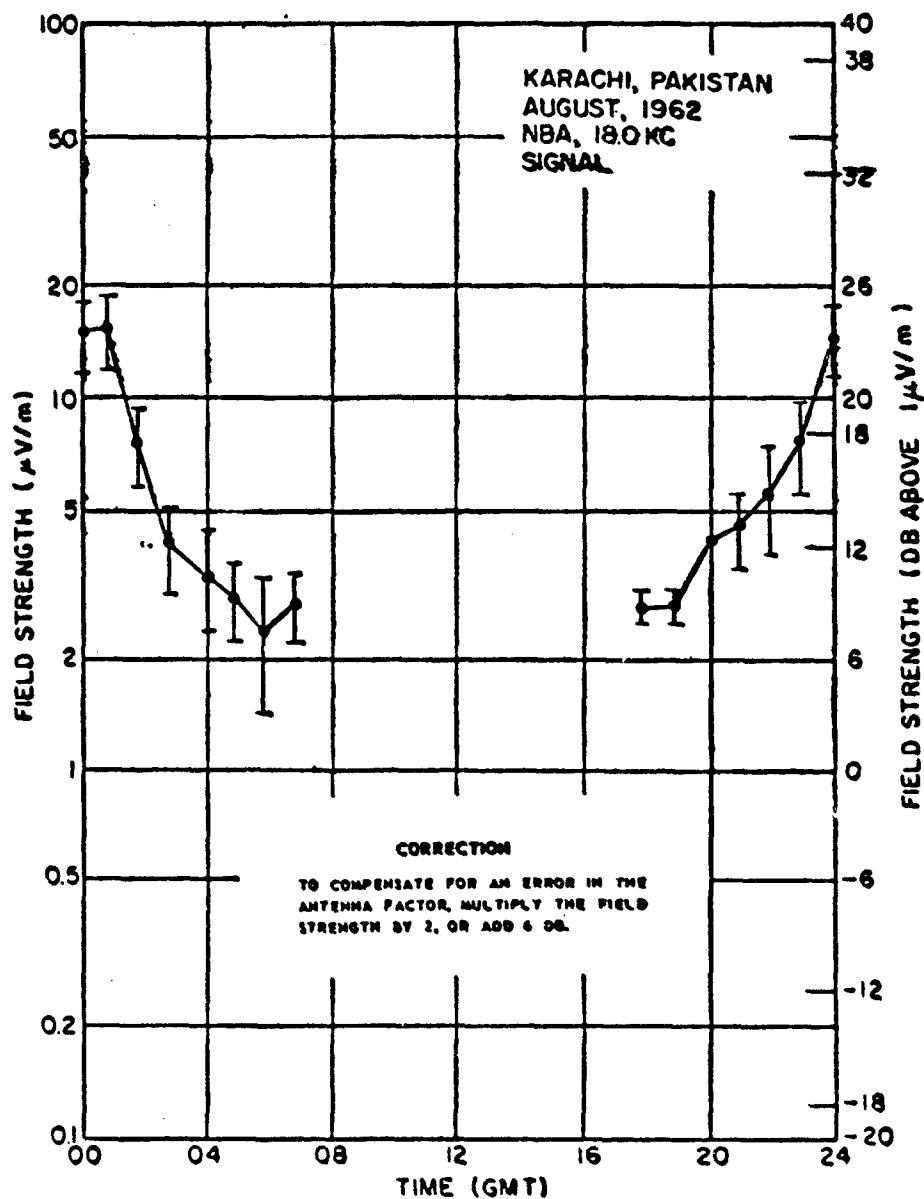


Figure 196

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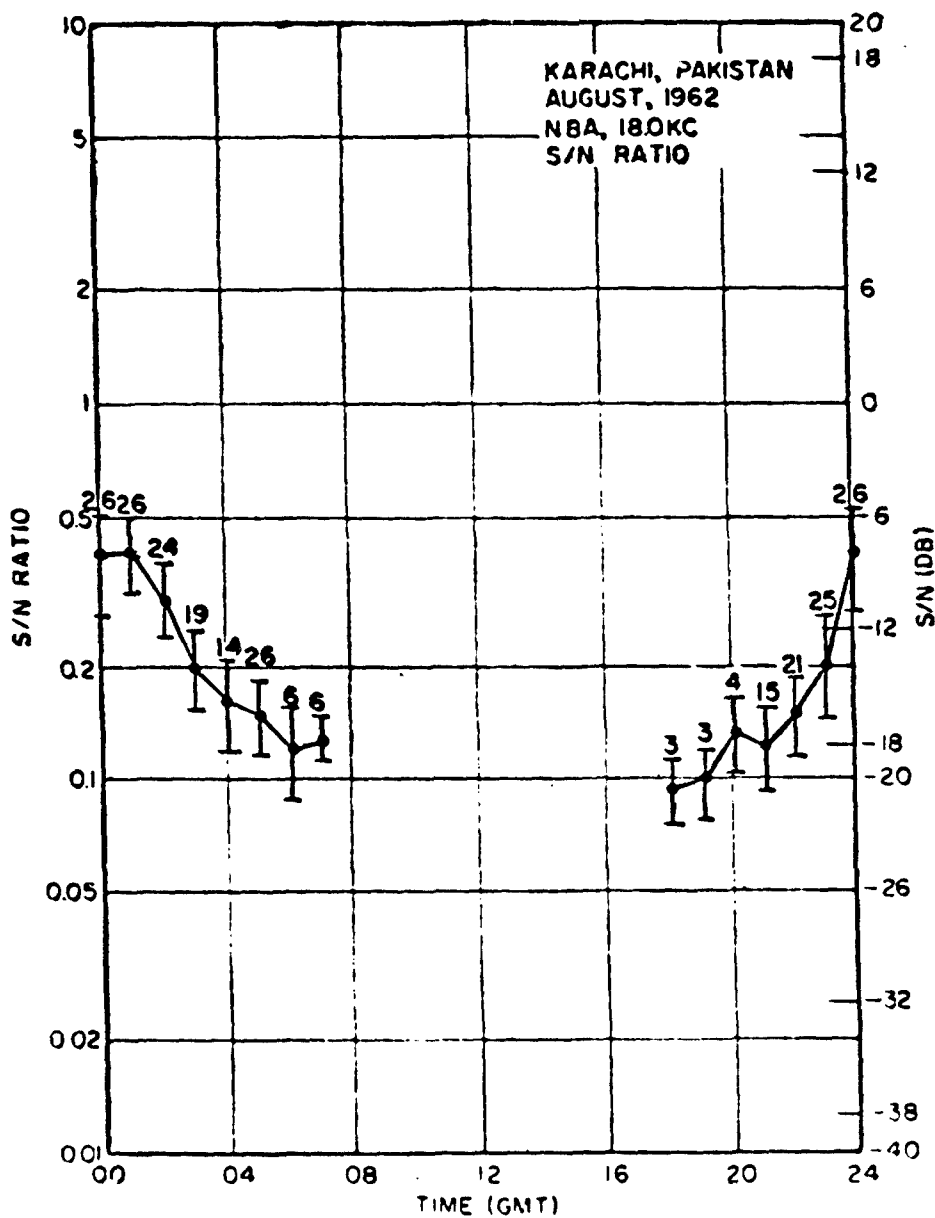


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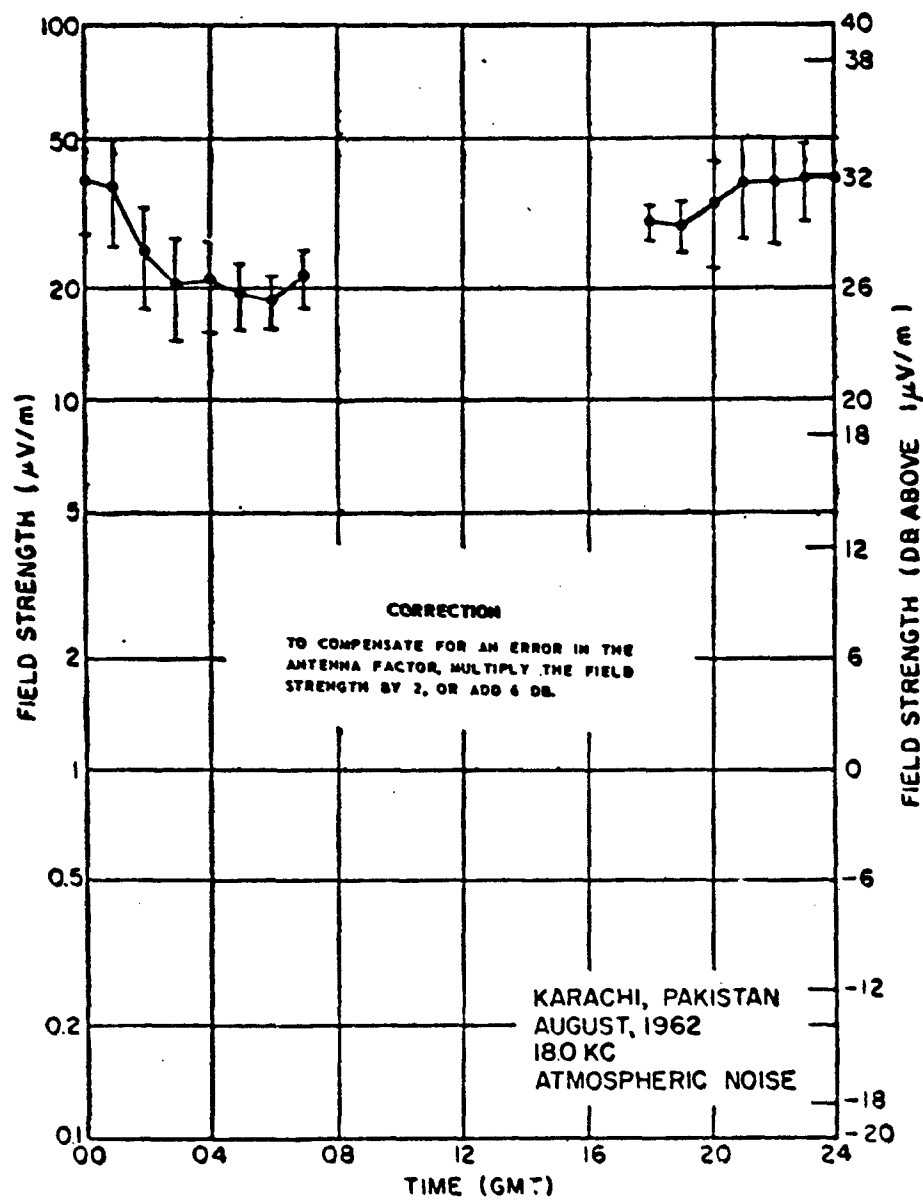


Figure 198

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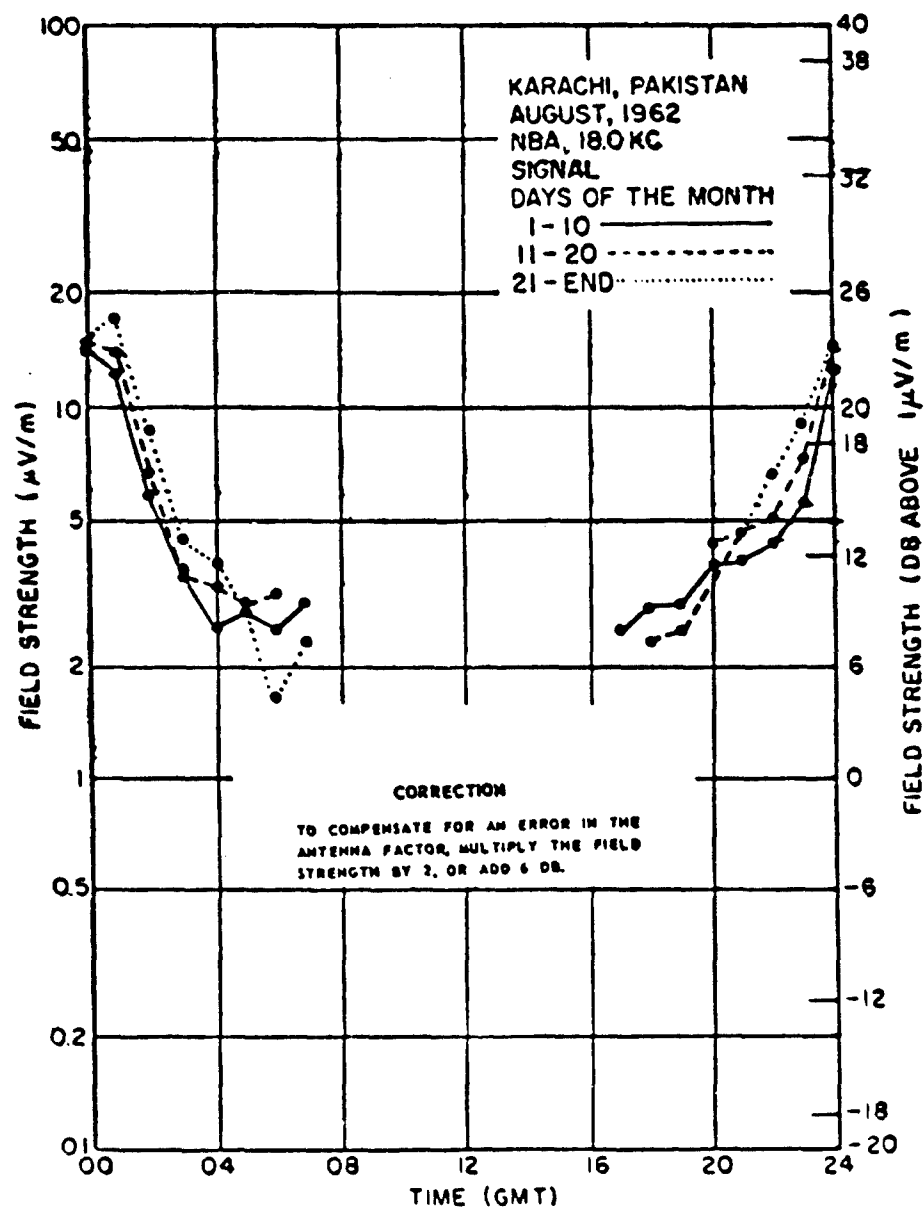


Figure 199

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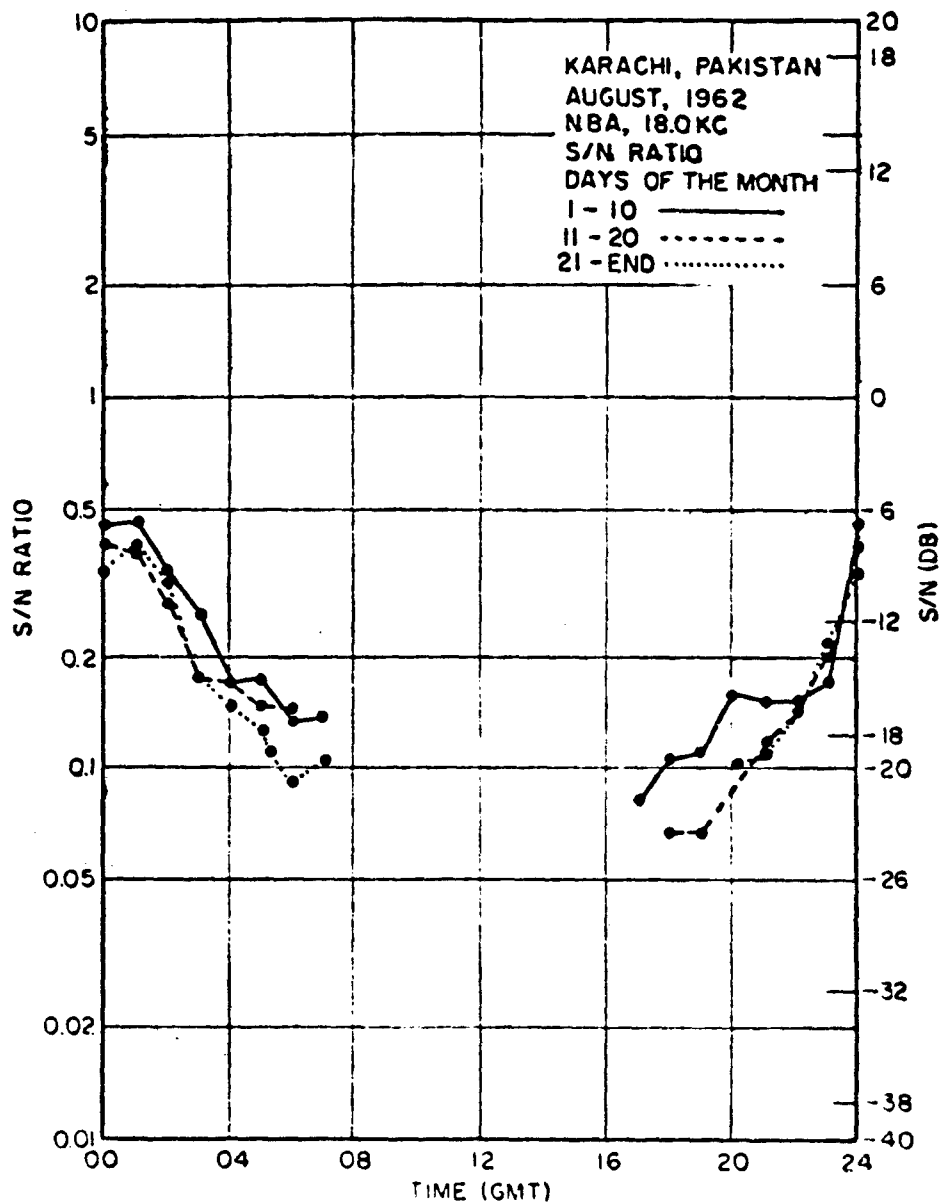


Figure 200

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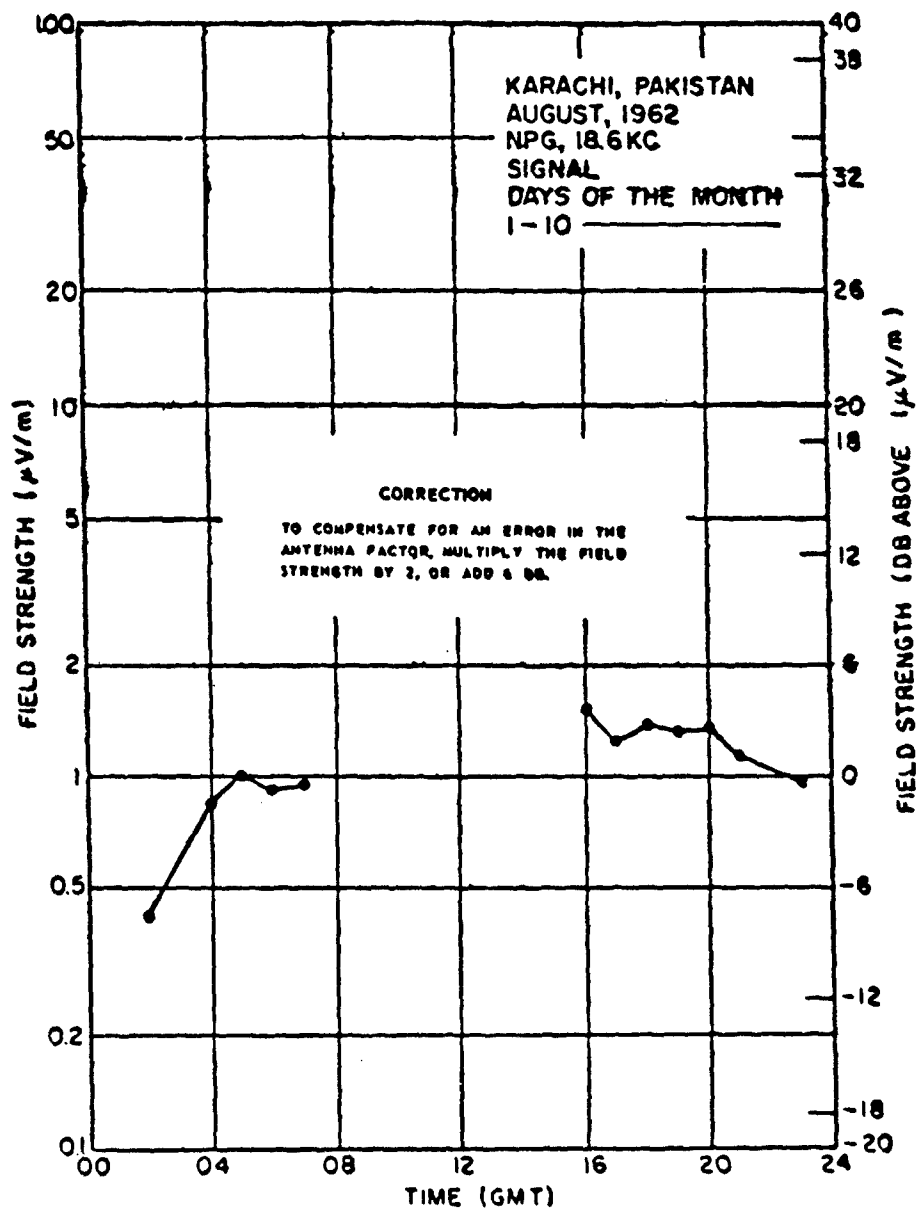


Figure 201

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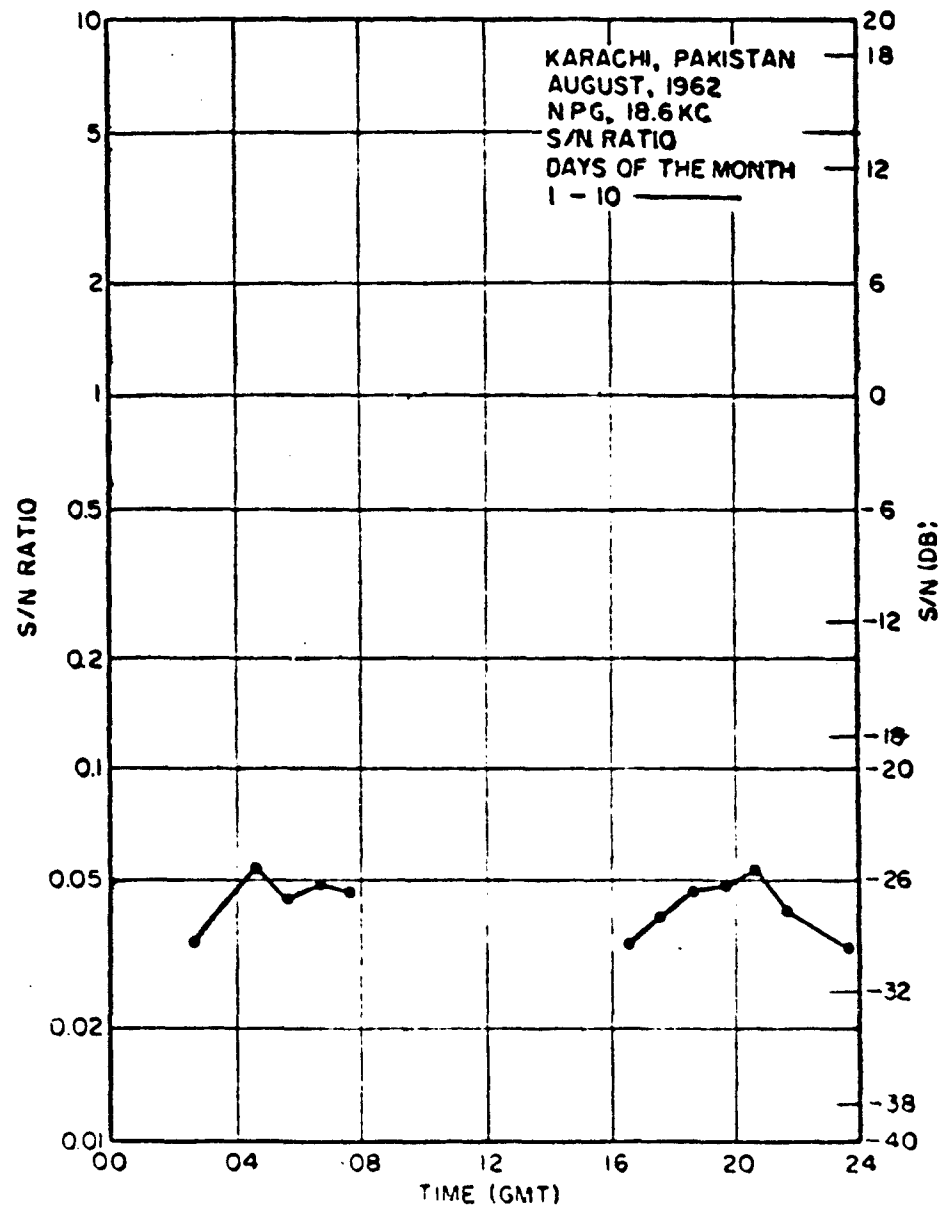


Figure 202

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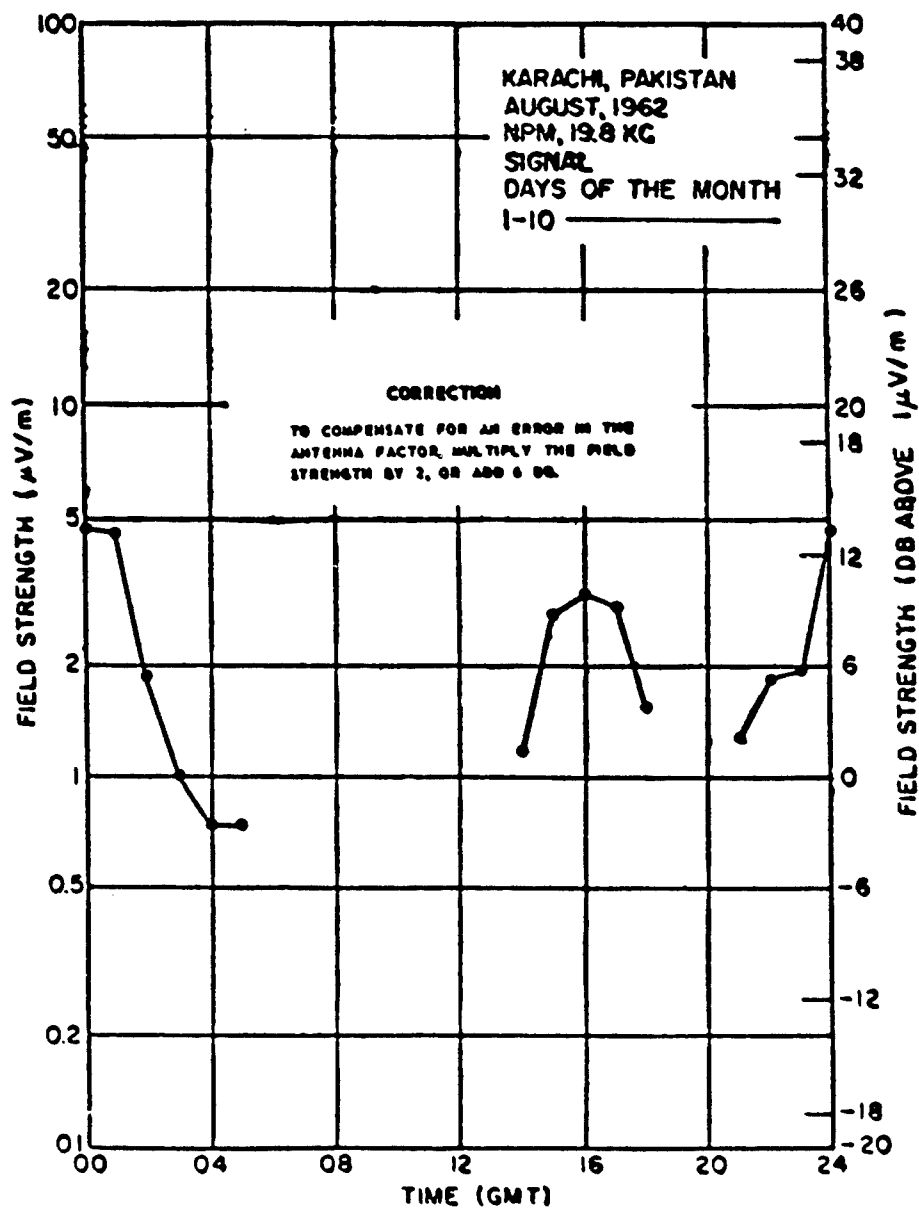


Figure 203

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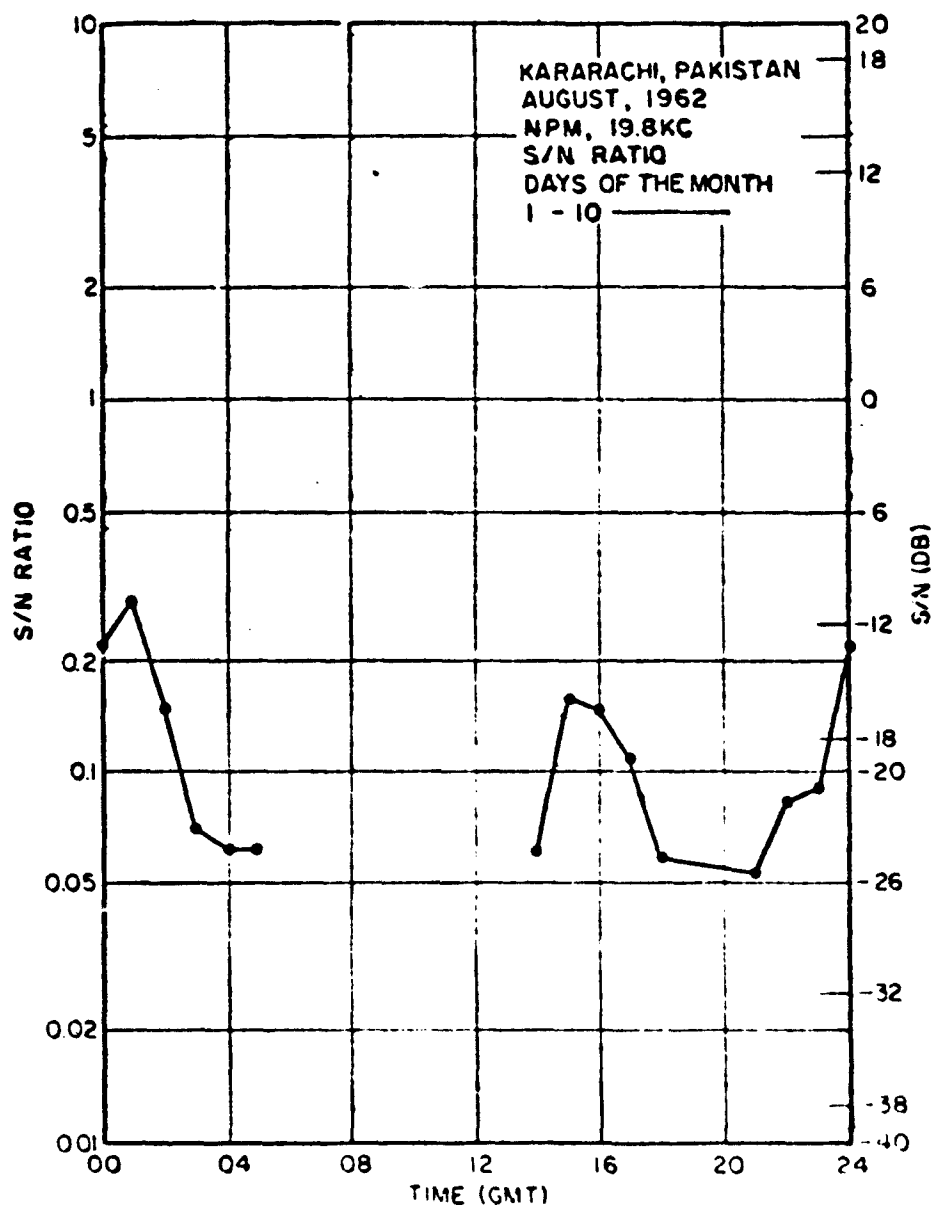


Figure 204

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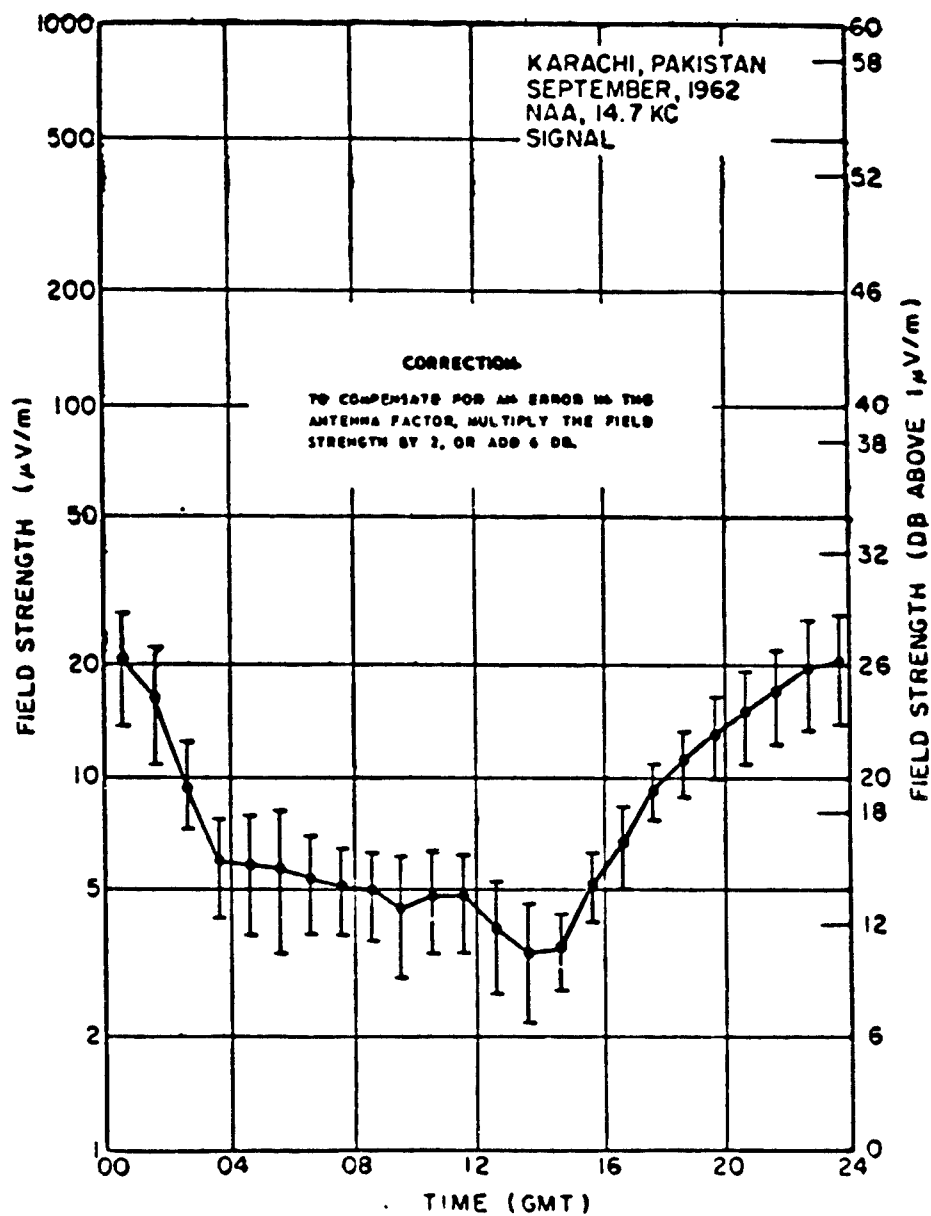


Figure 205

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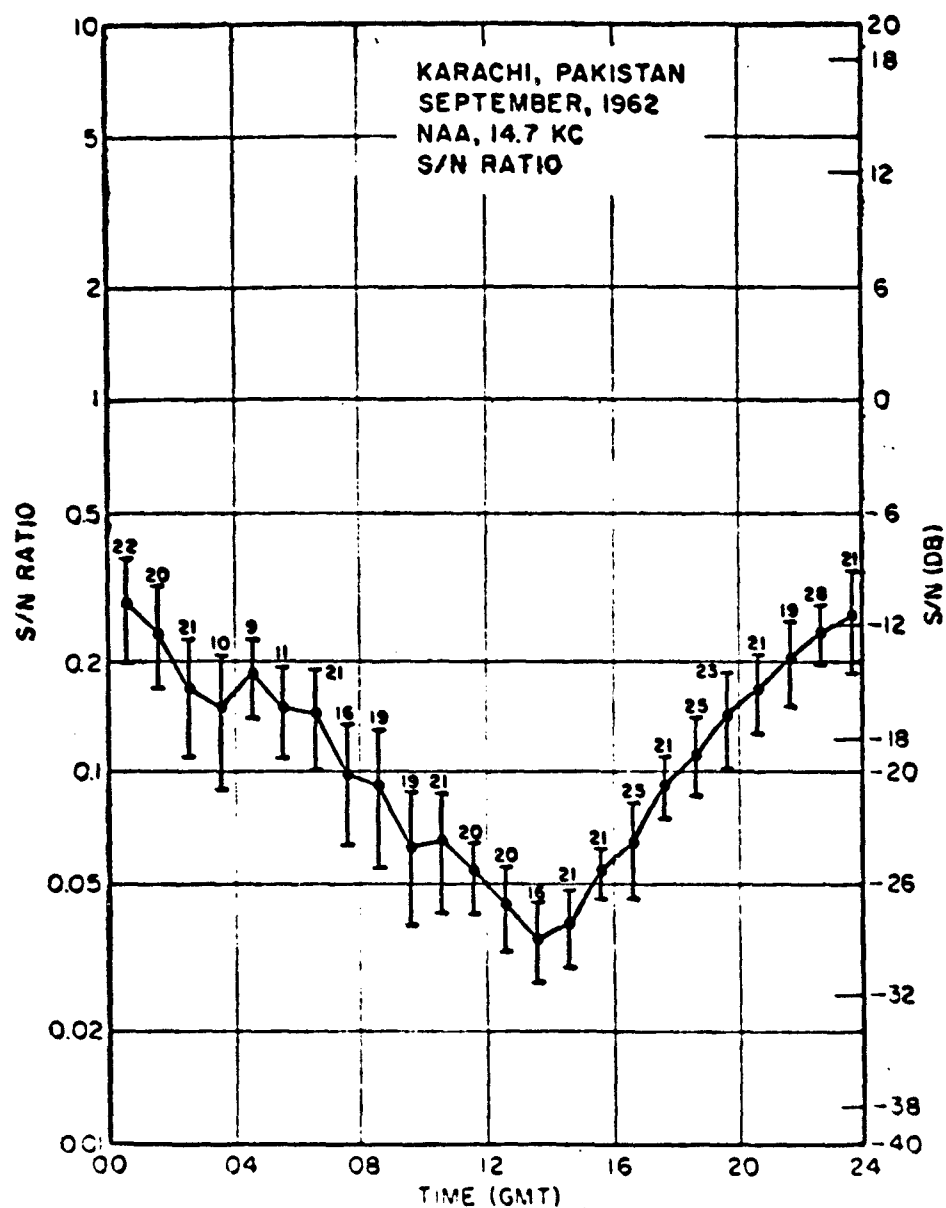


Figure 206

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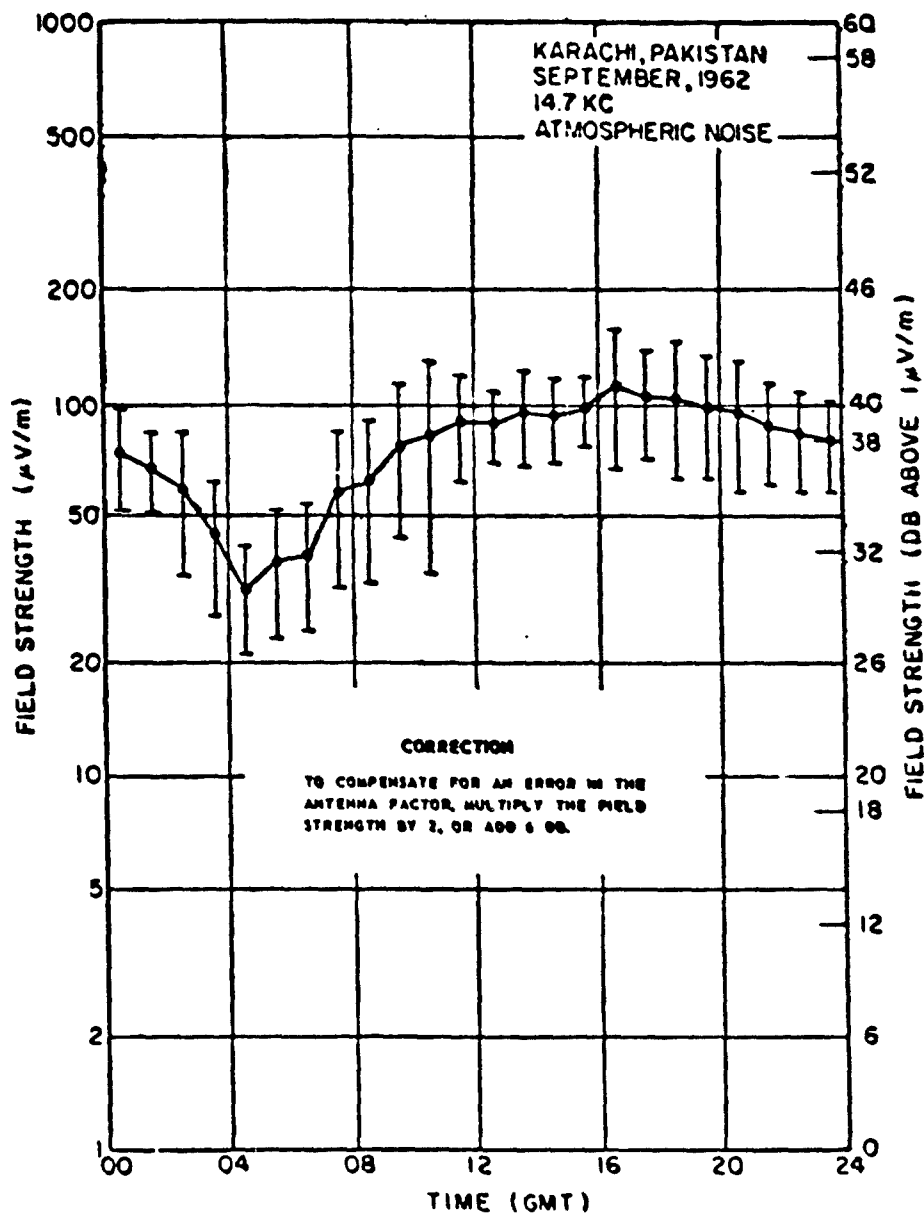


Figure 207

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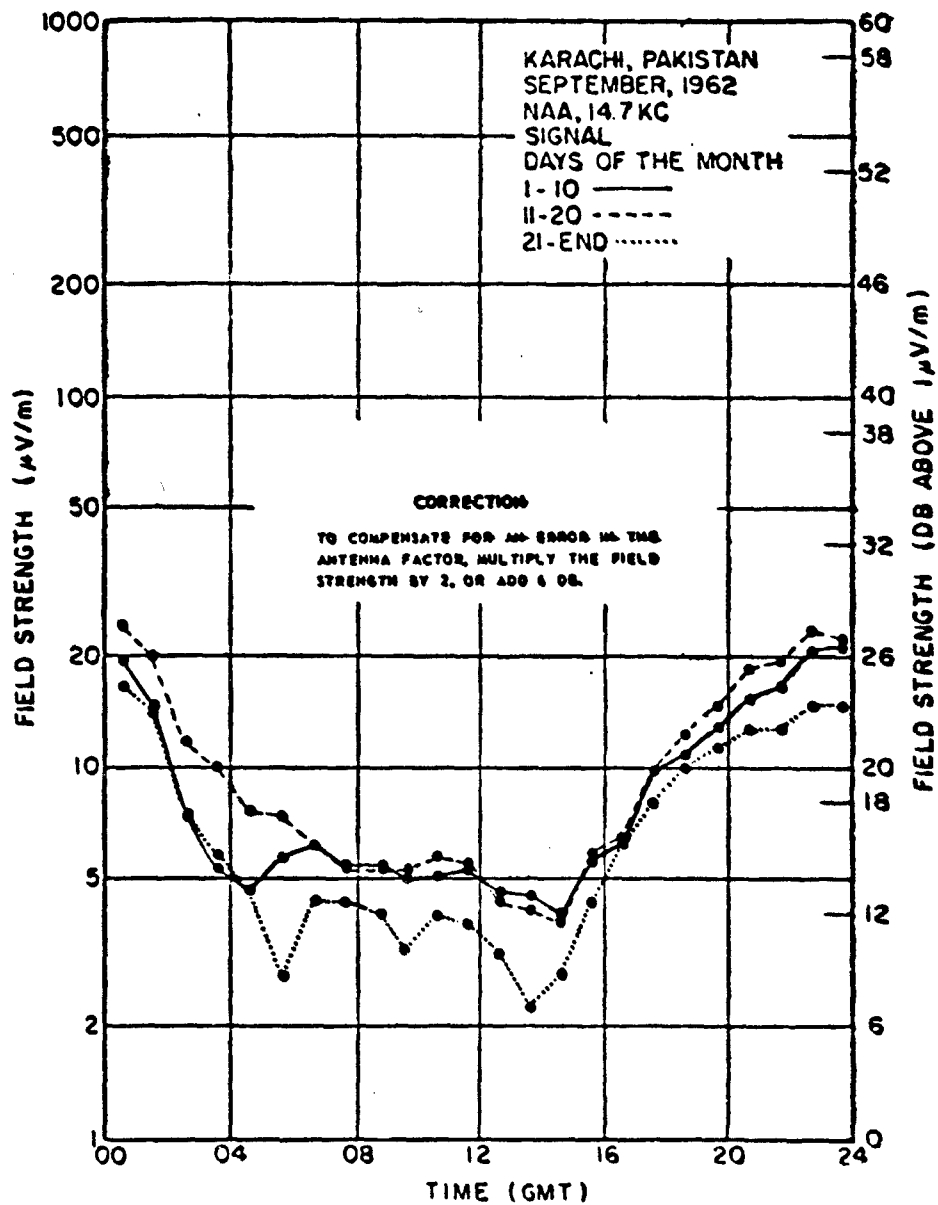


Figure 208

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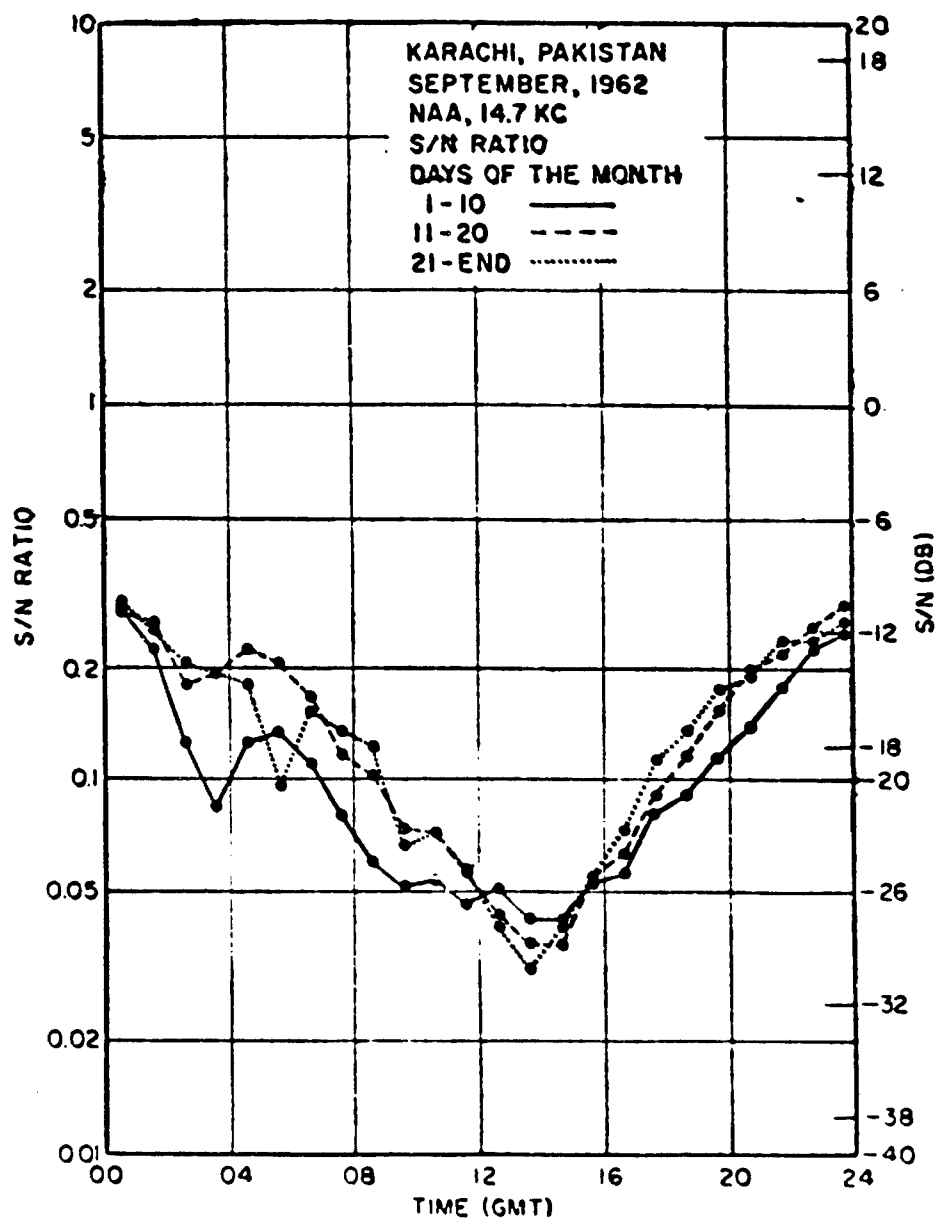


Figure 209

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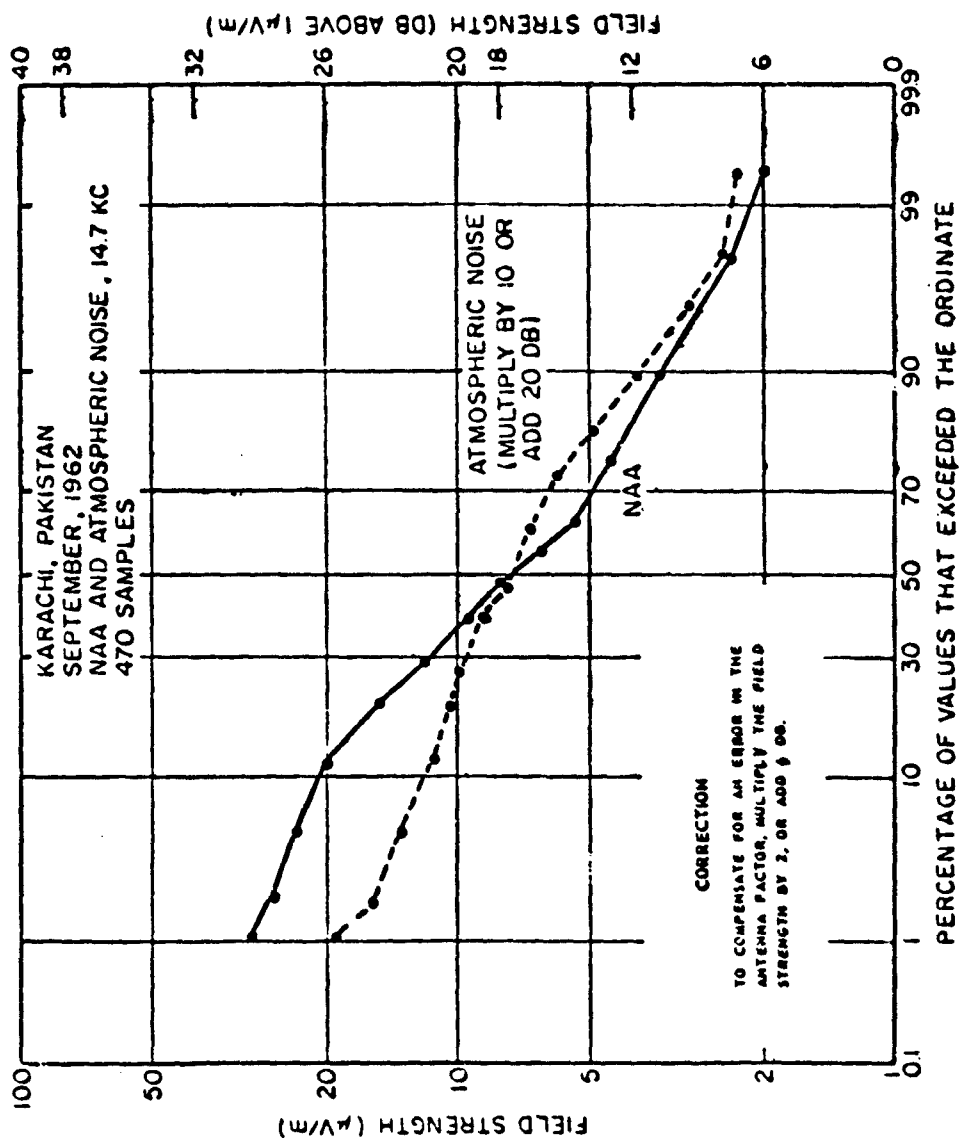


Figure 210

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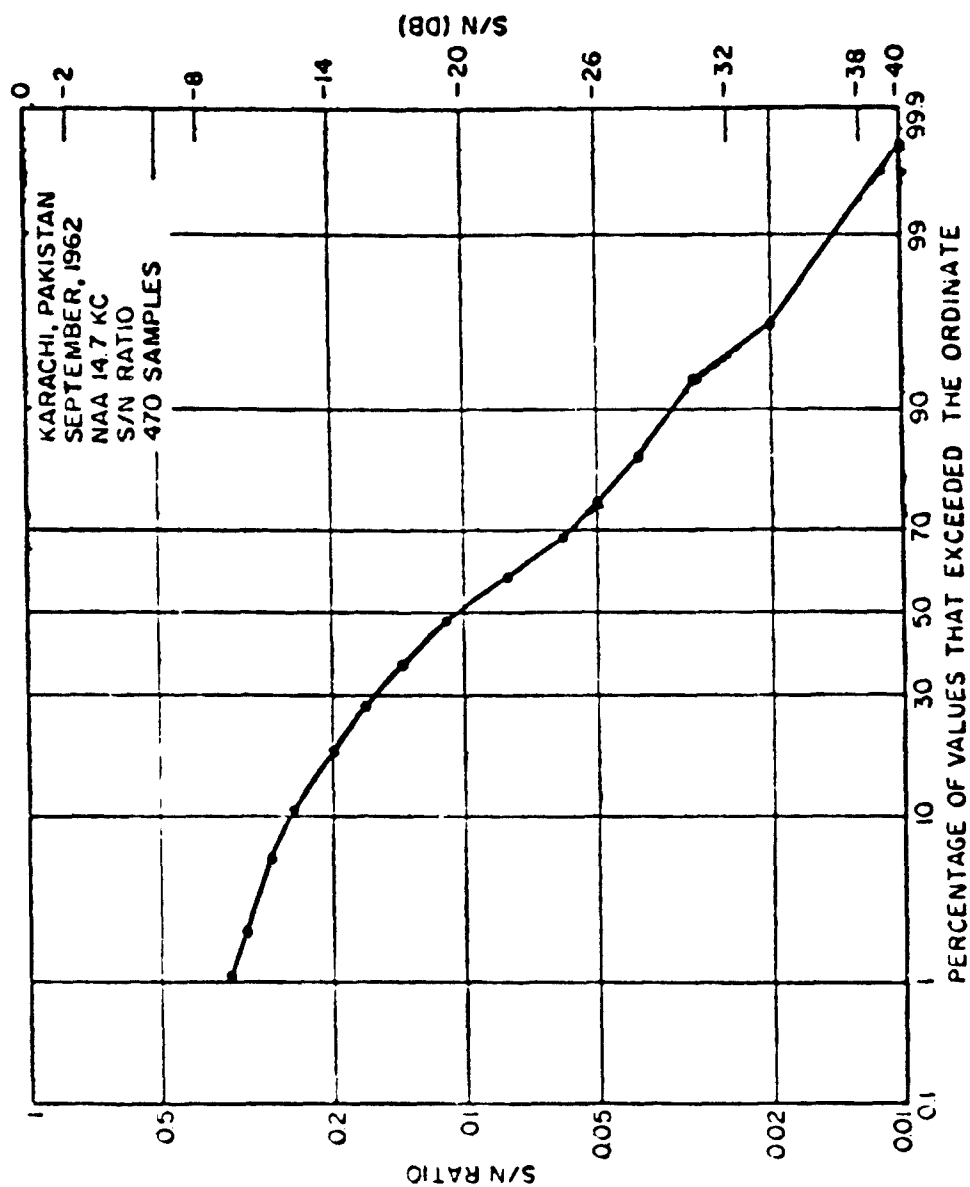


Figure 211

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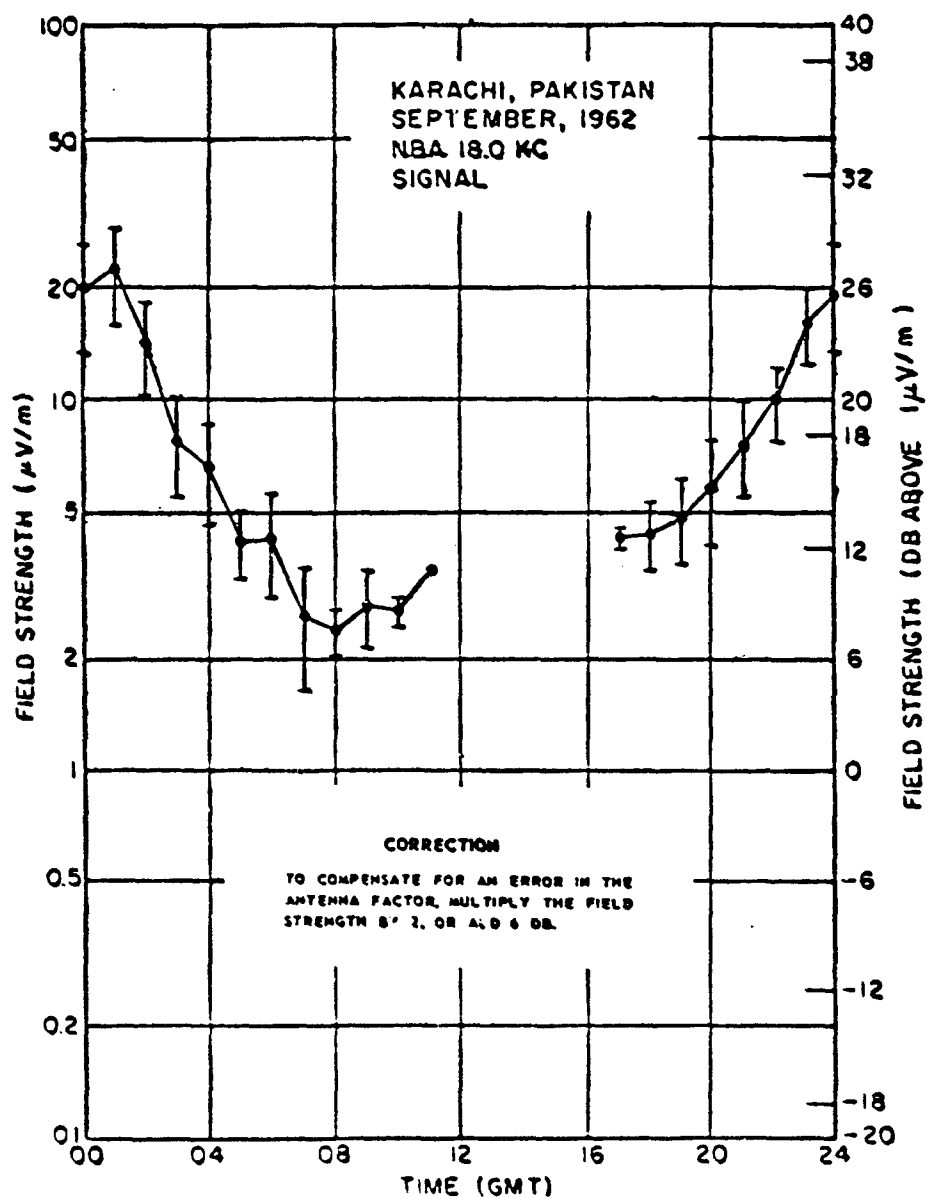


Figure 212

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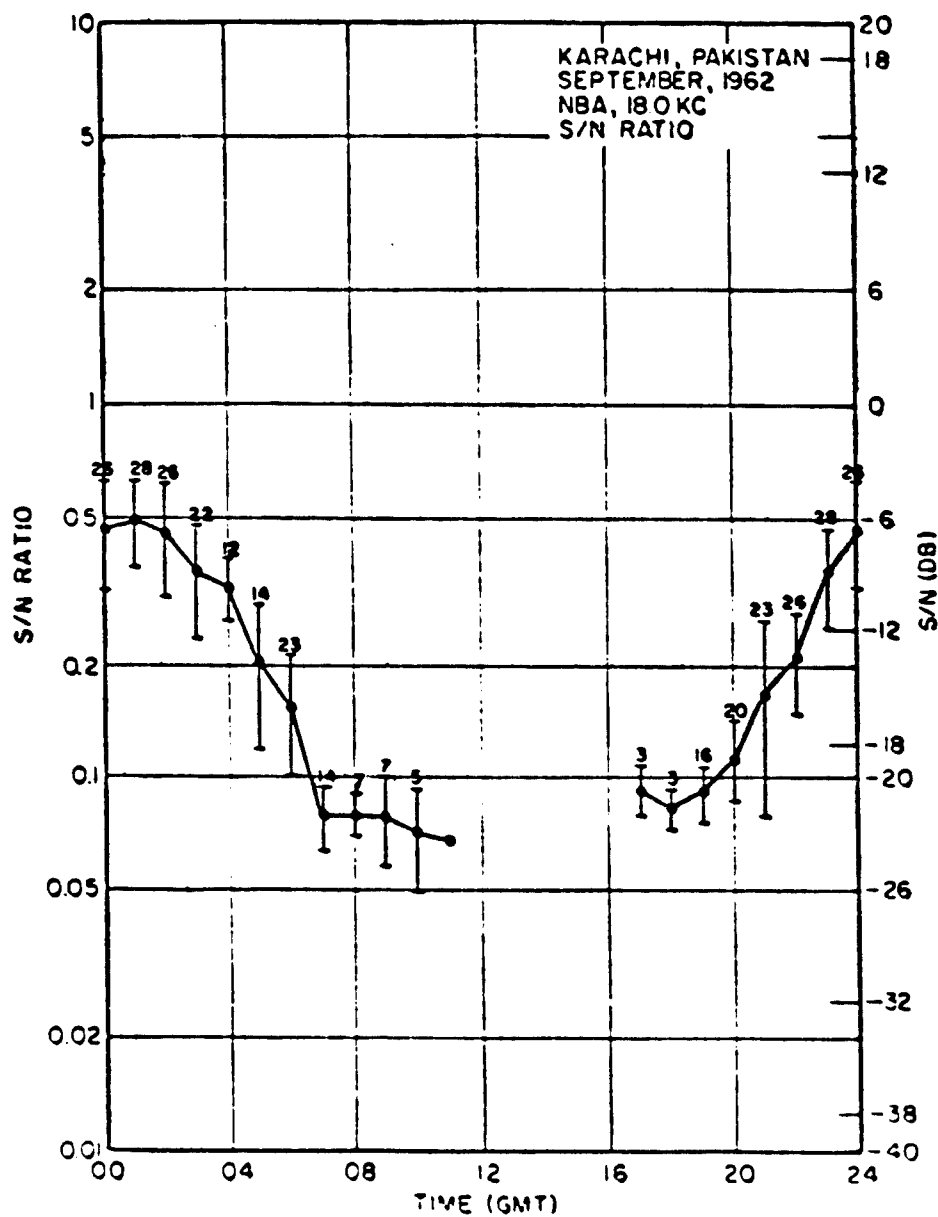


Figure 213

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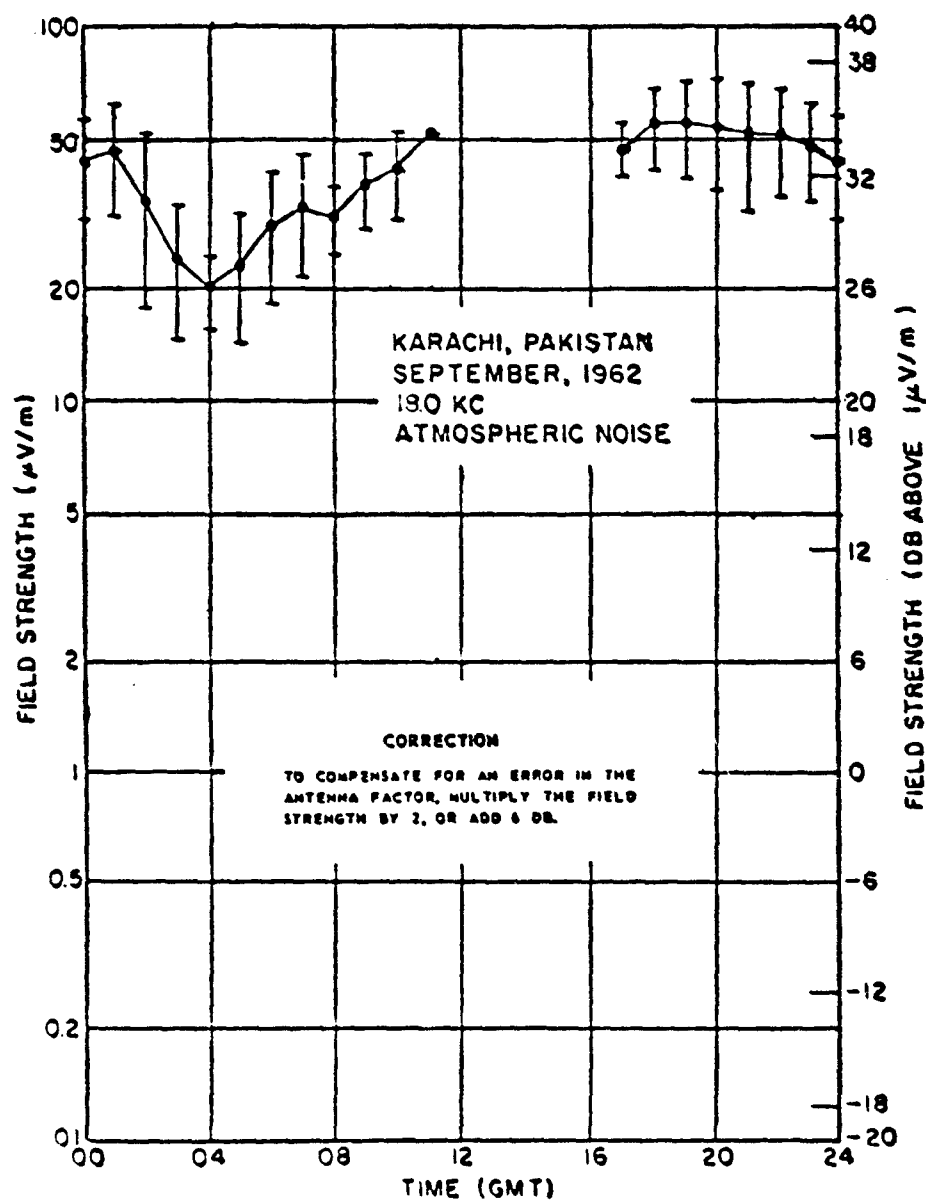


Figure 214

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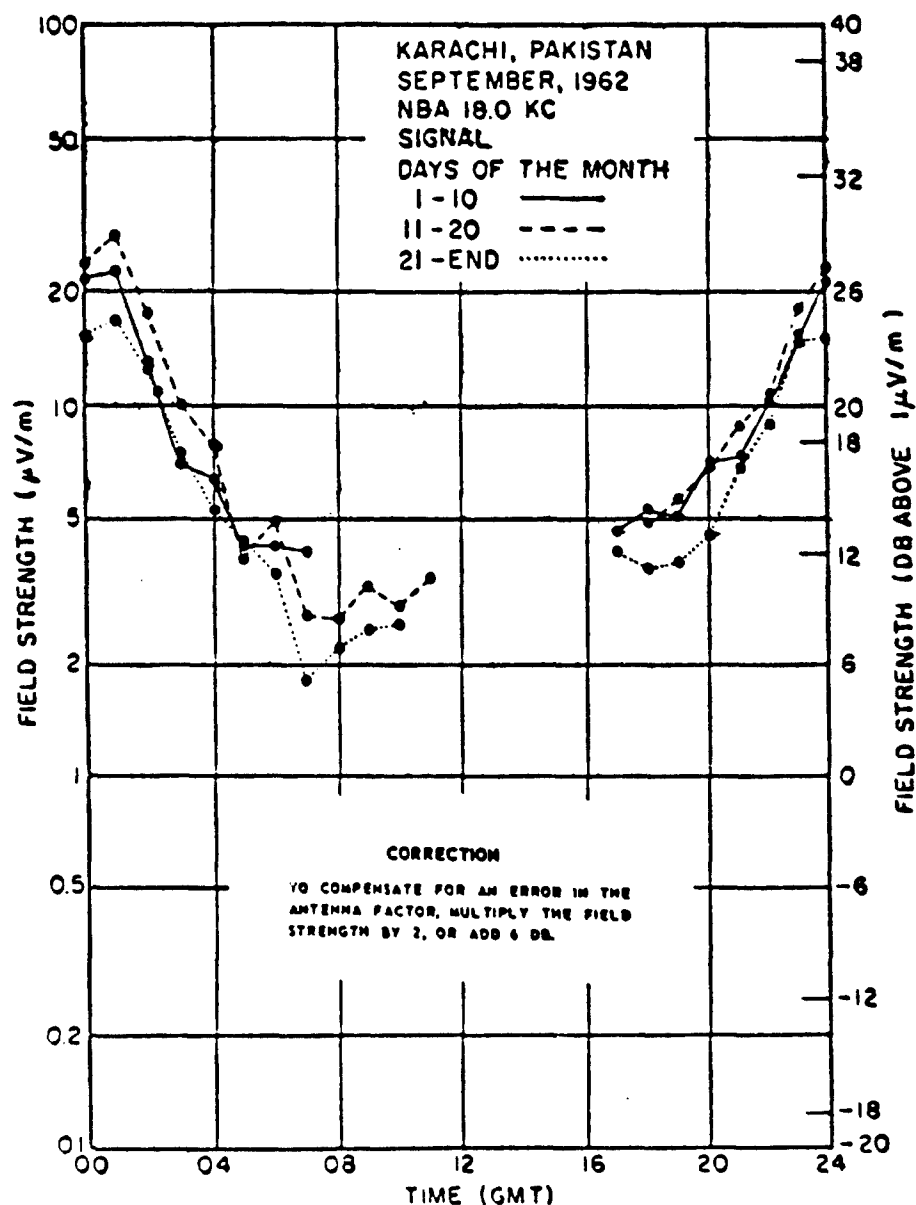


Figure 215

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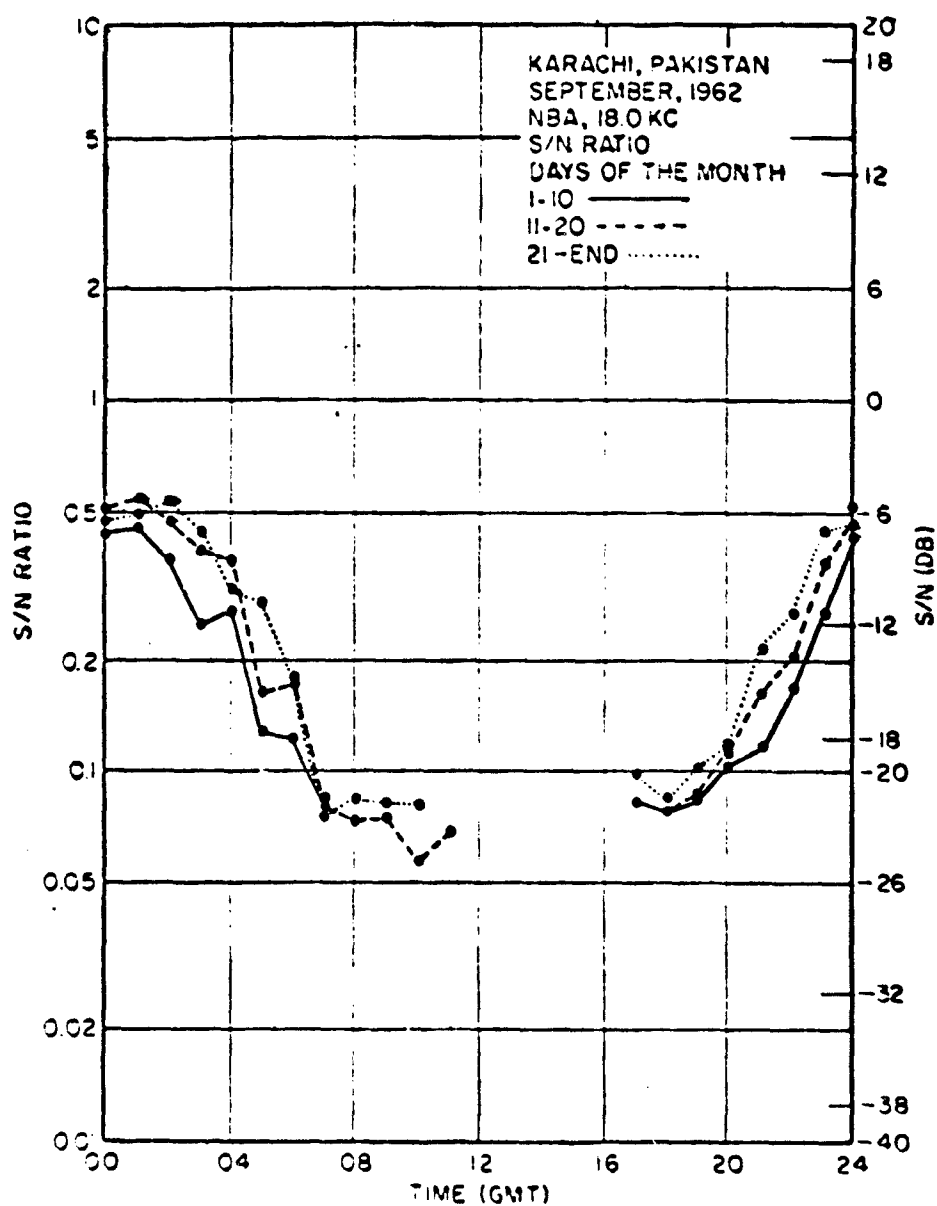


Figure 216

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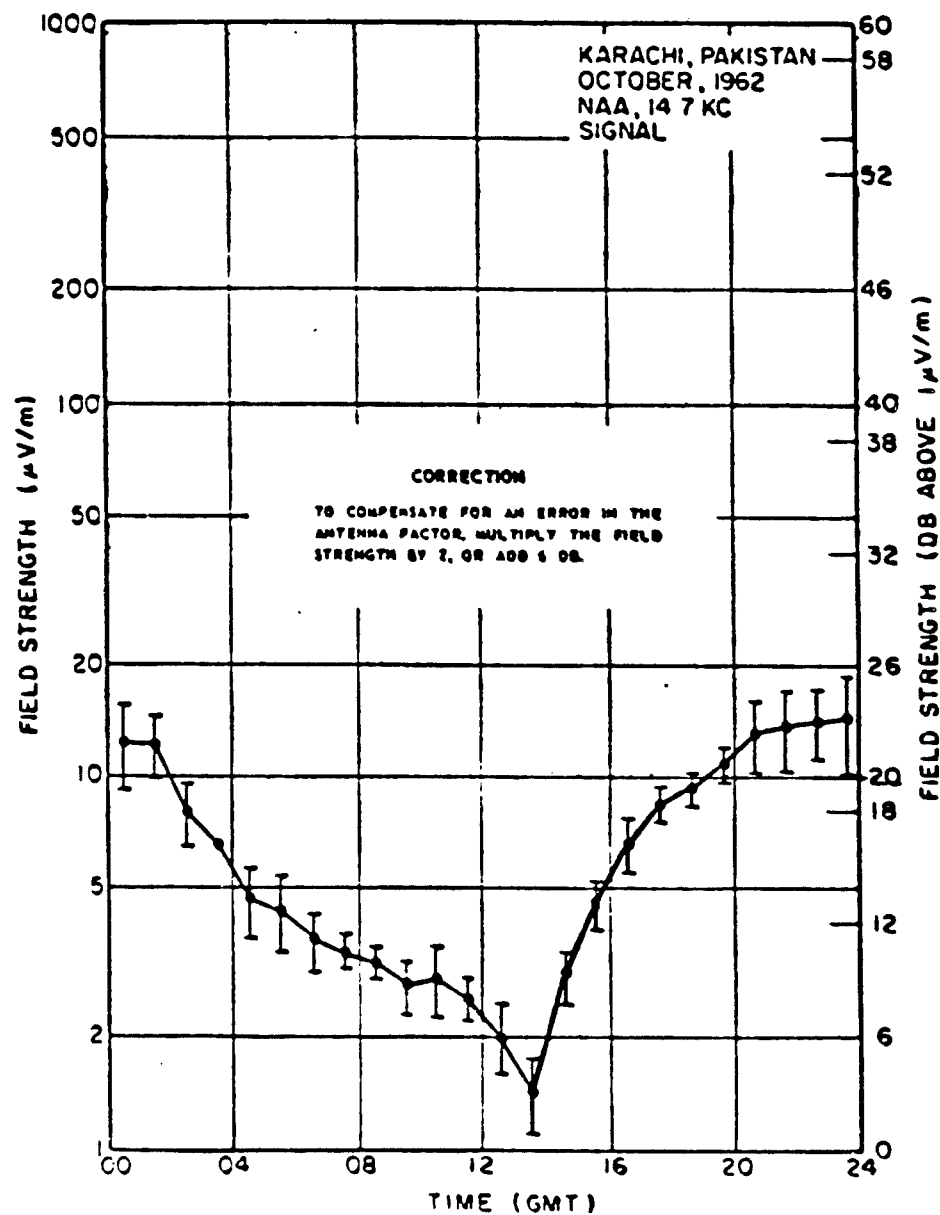


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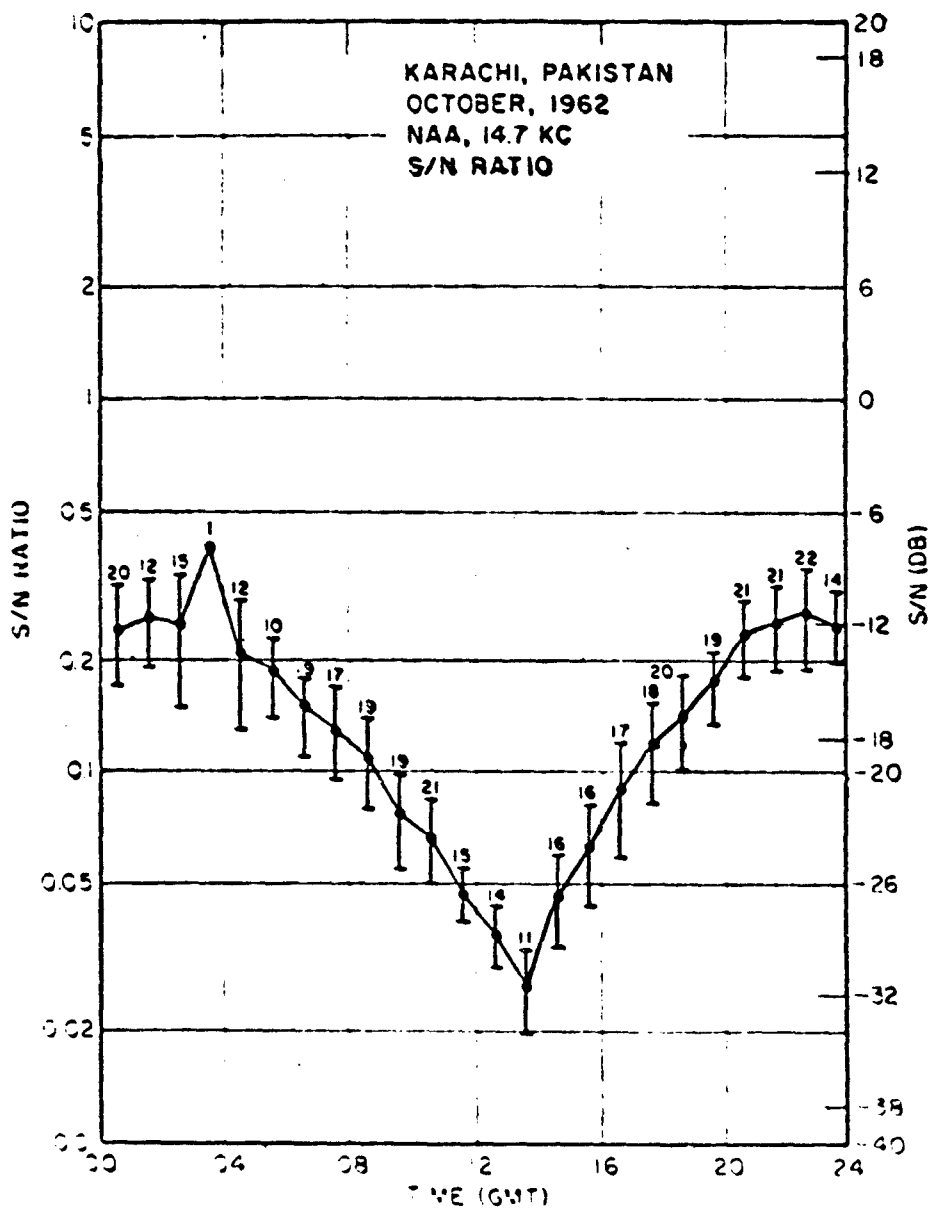


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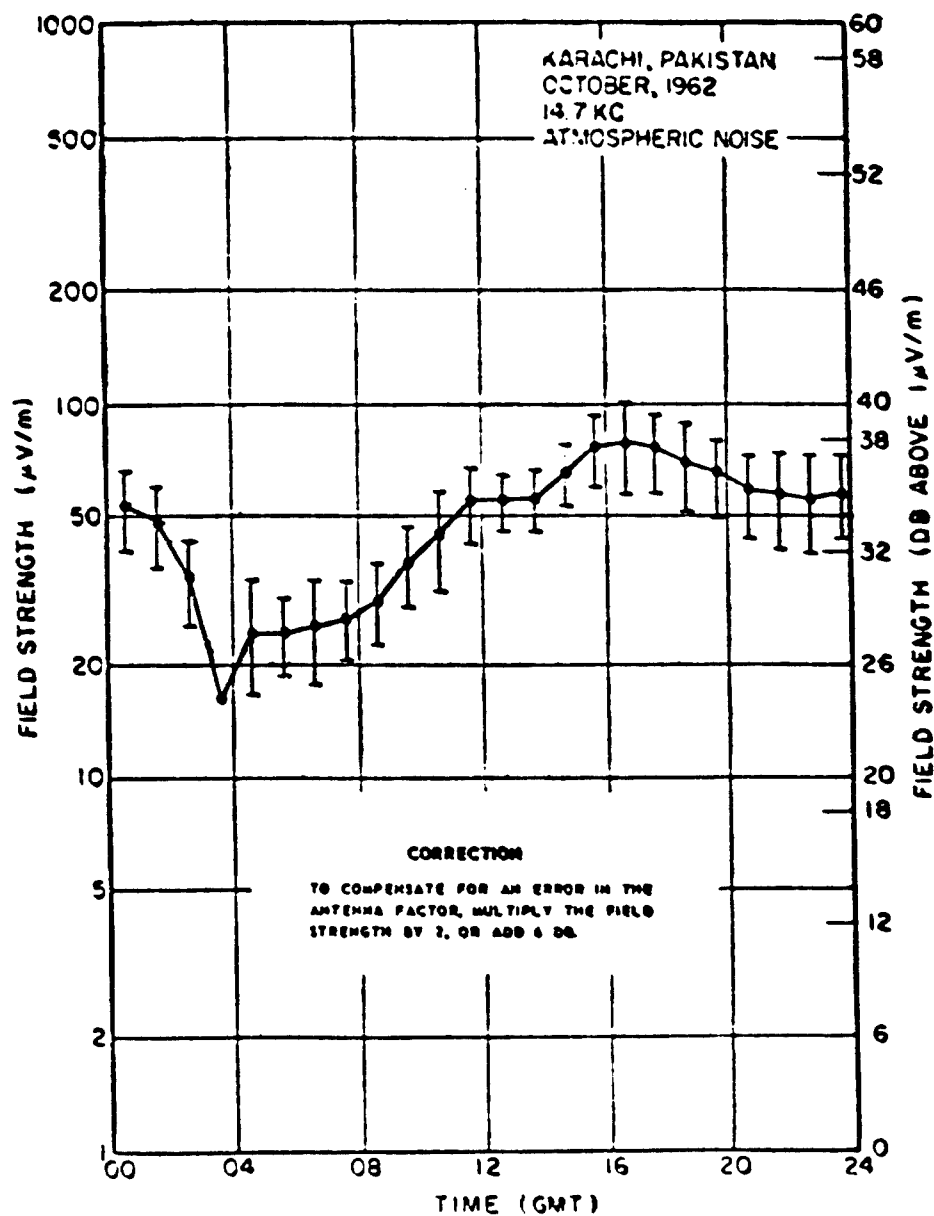


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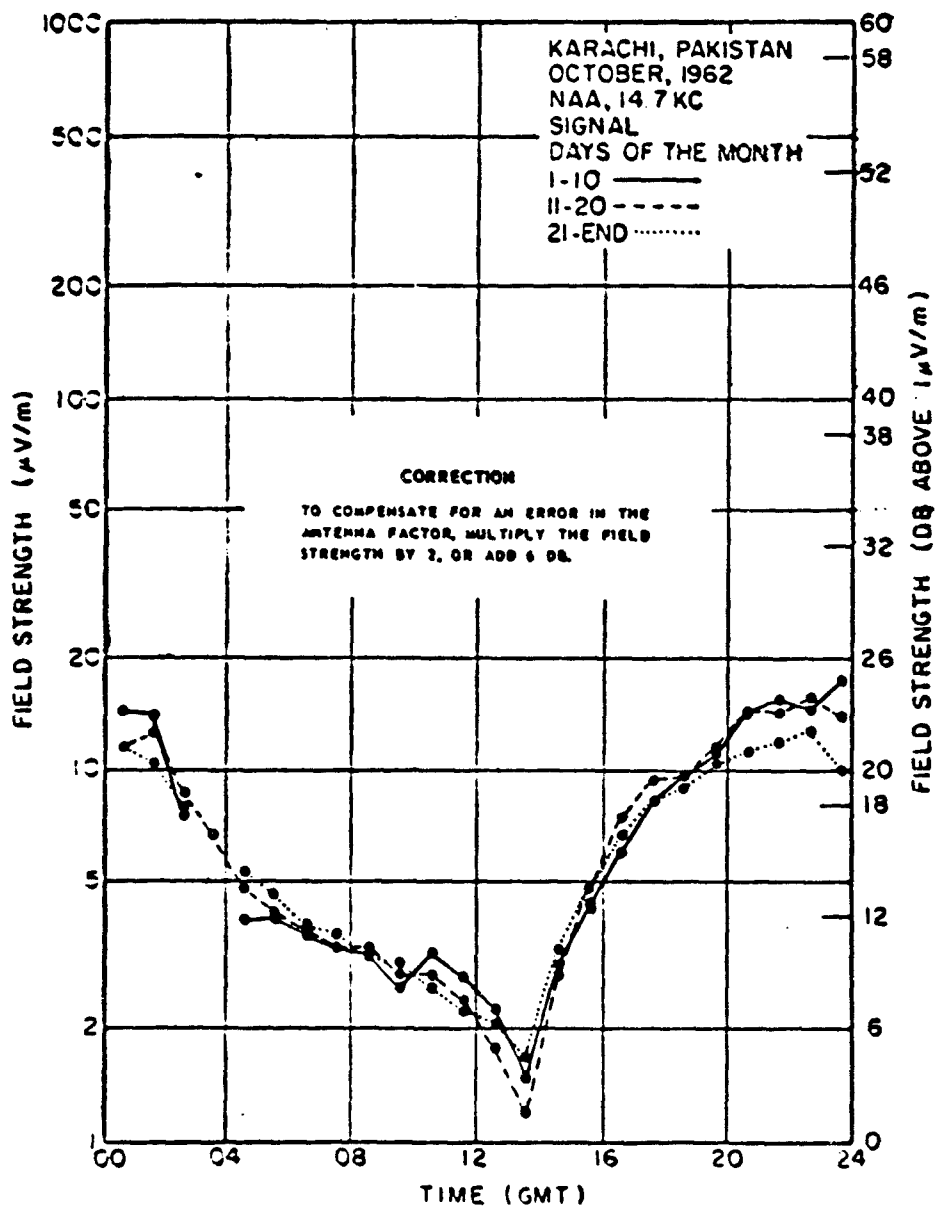


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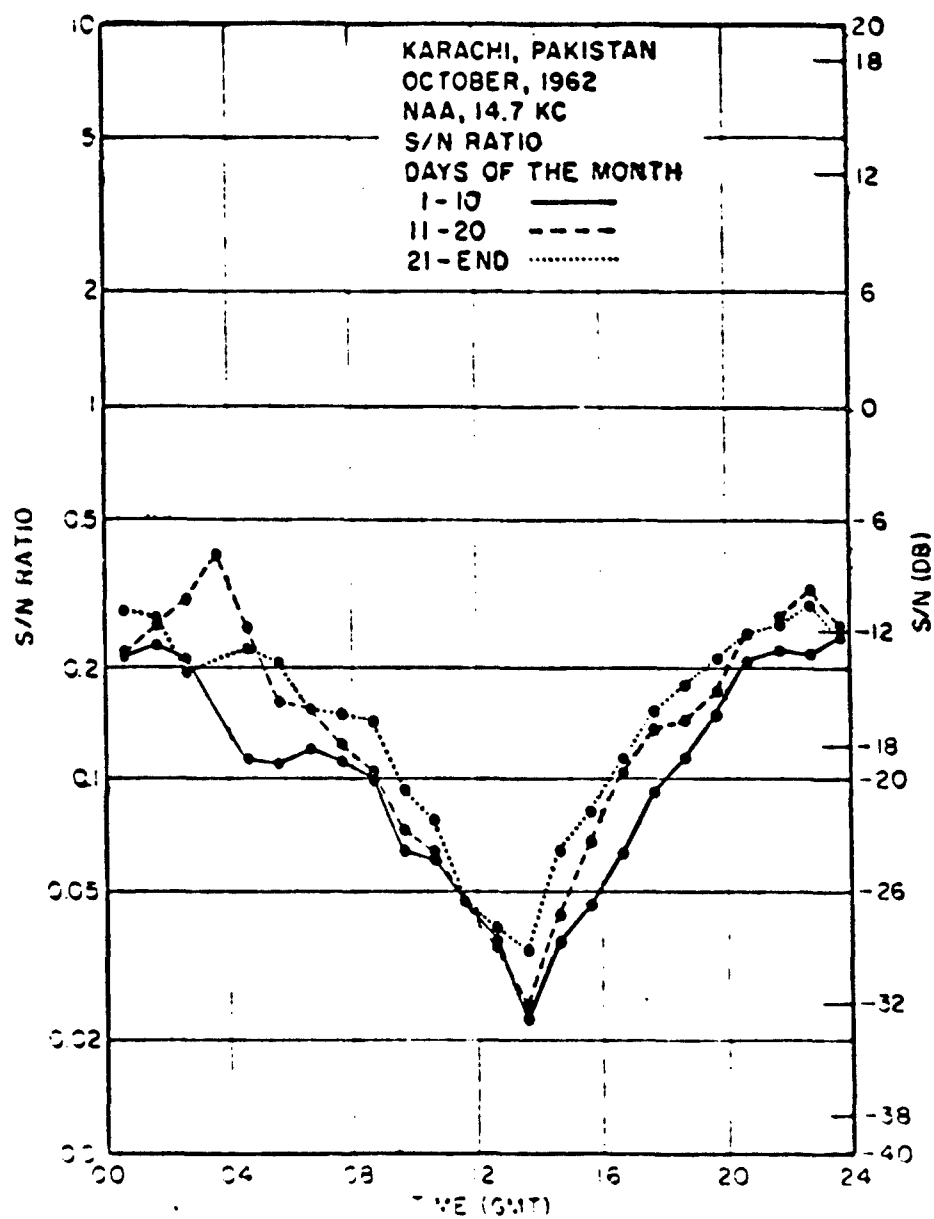


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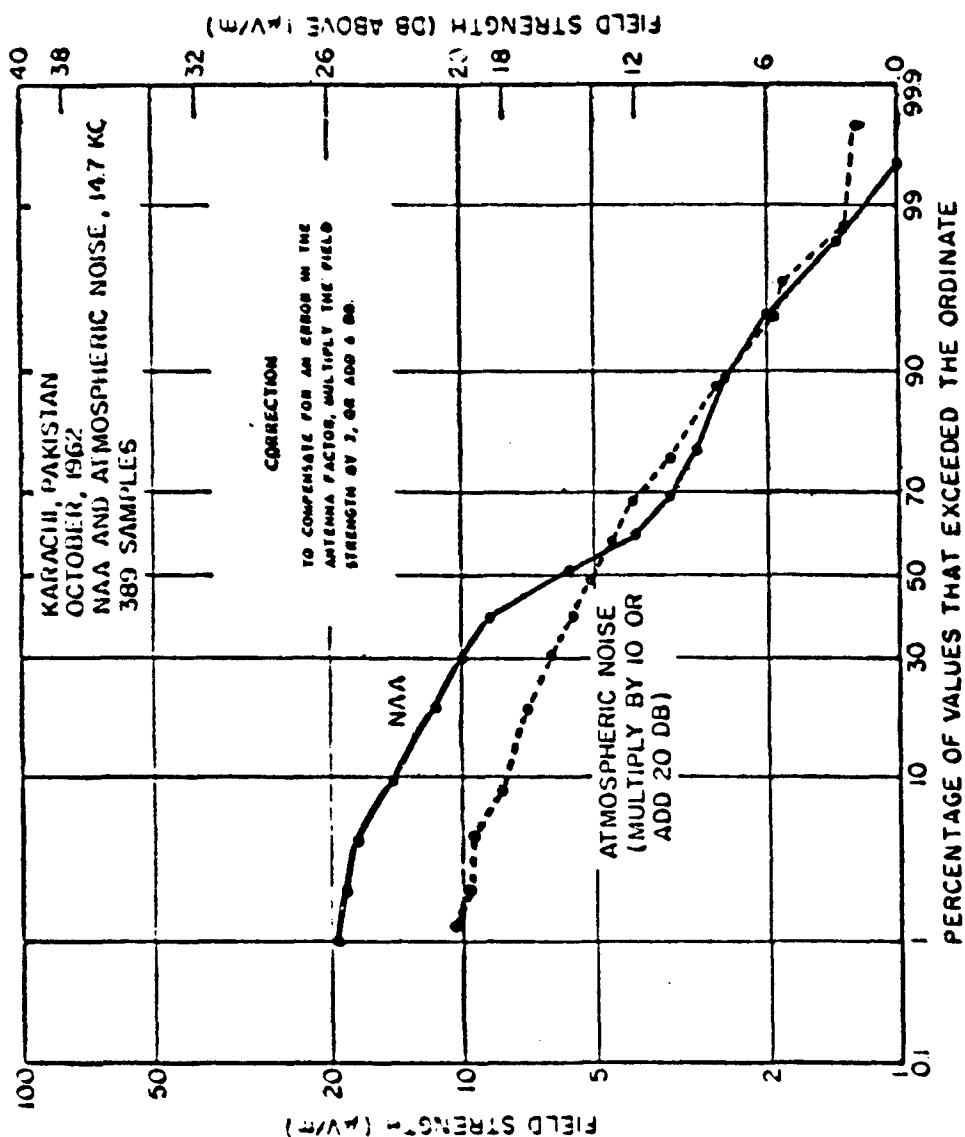


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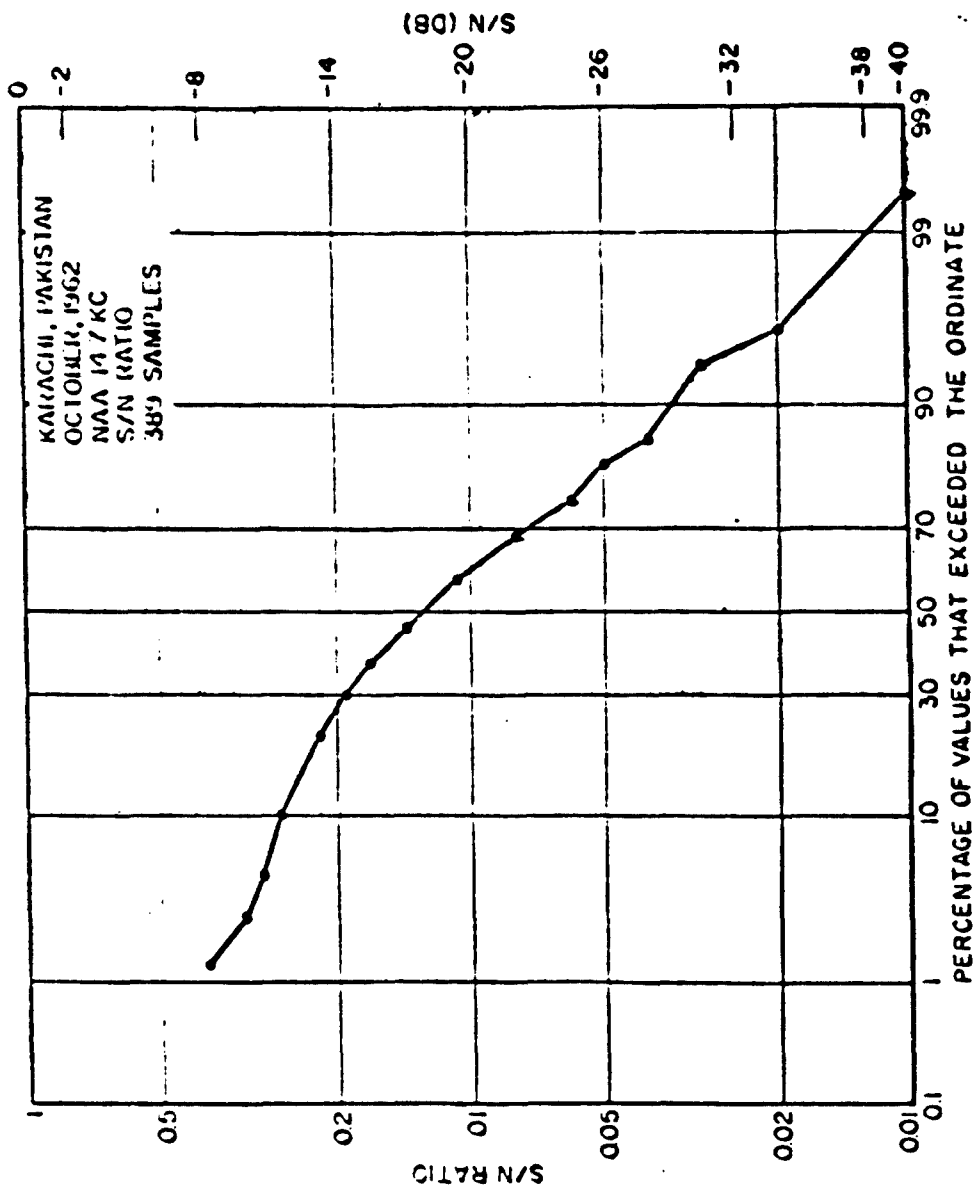


Figure 223

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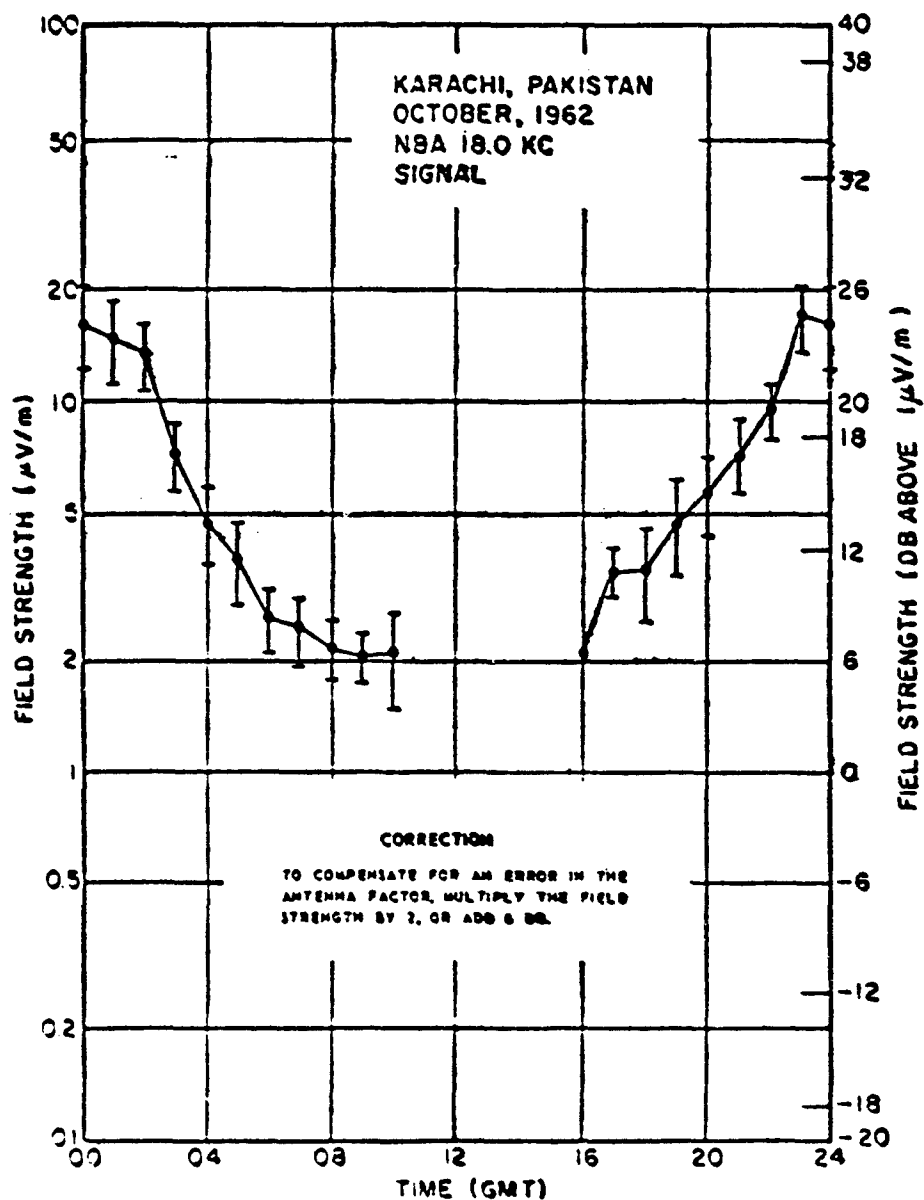


Figure 224

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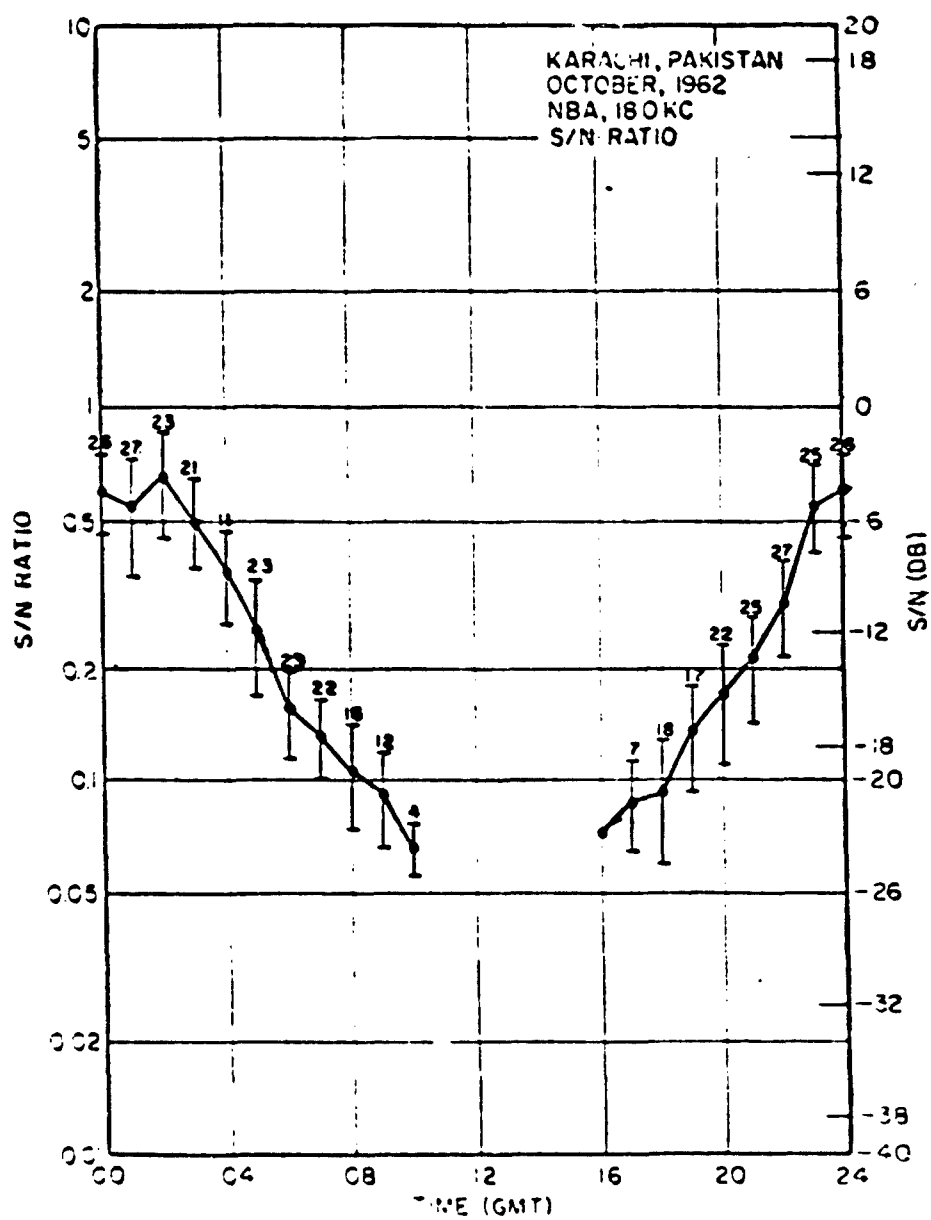


Figure 225

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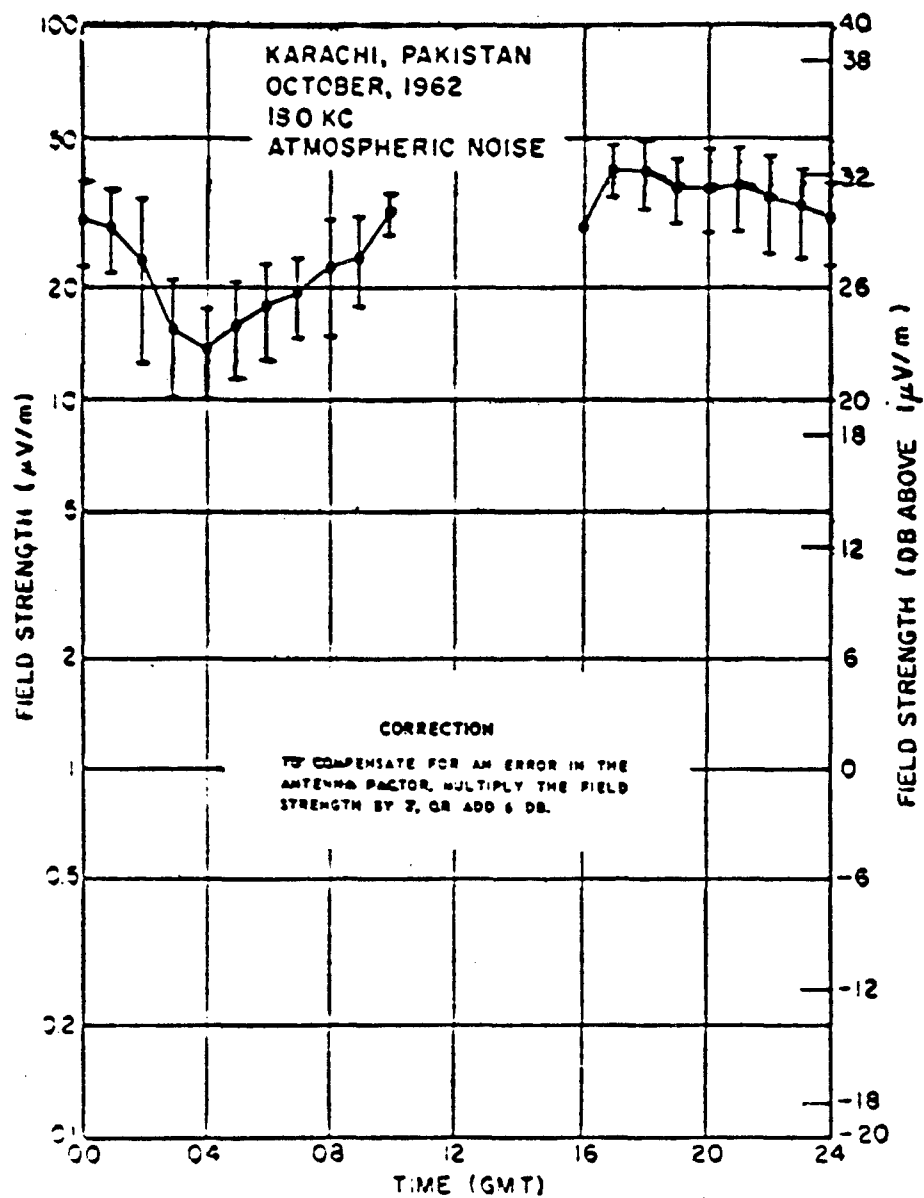


Figure 226

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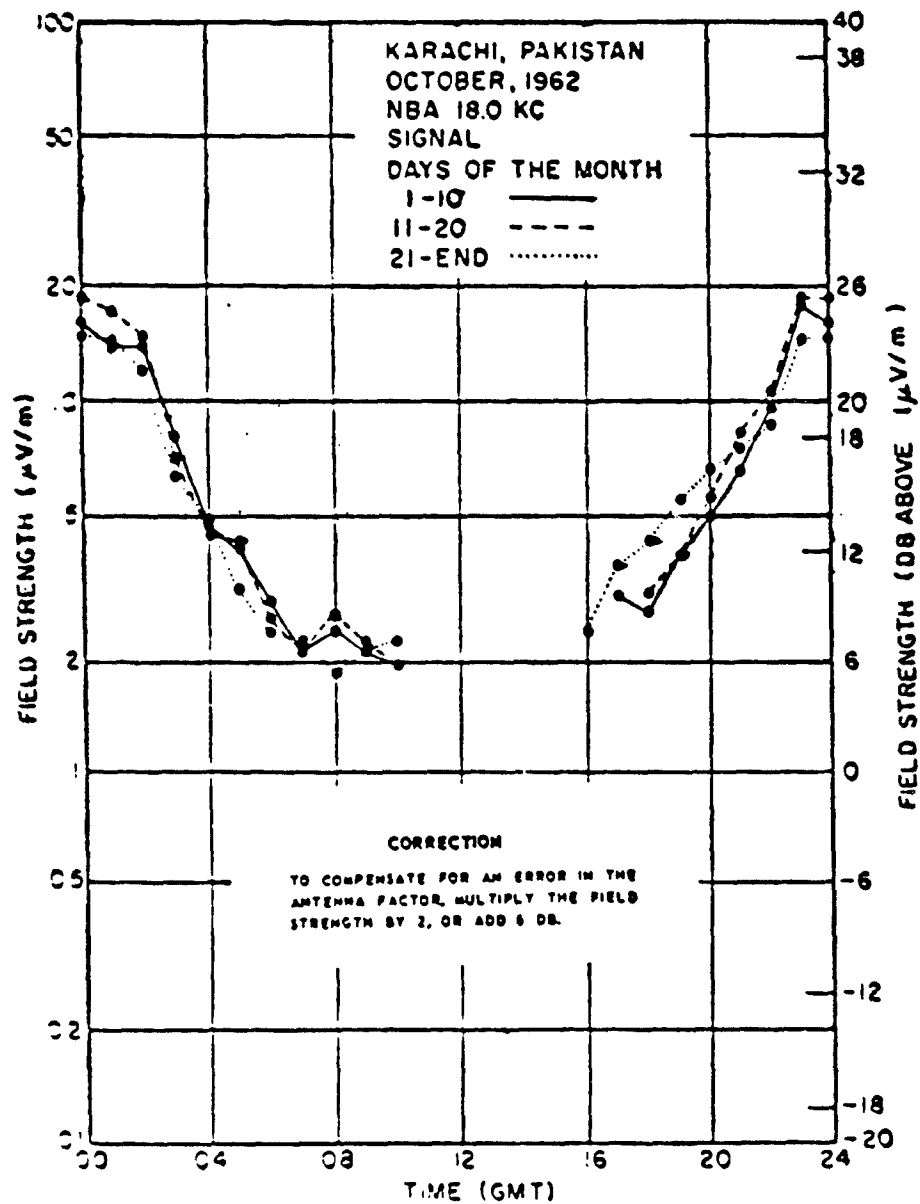


Figure 227

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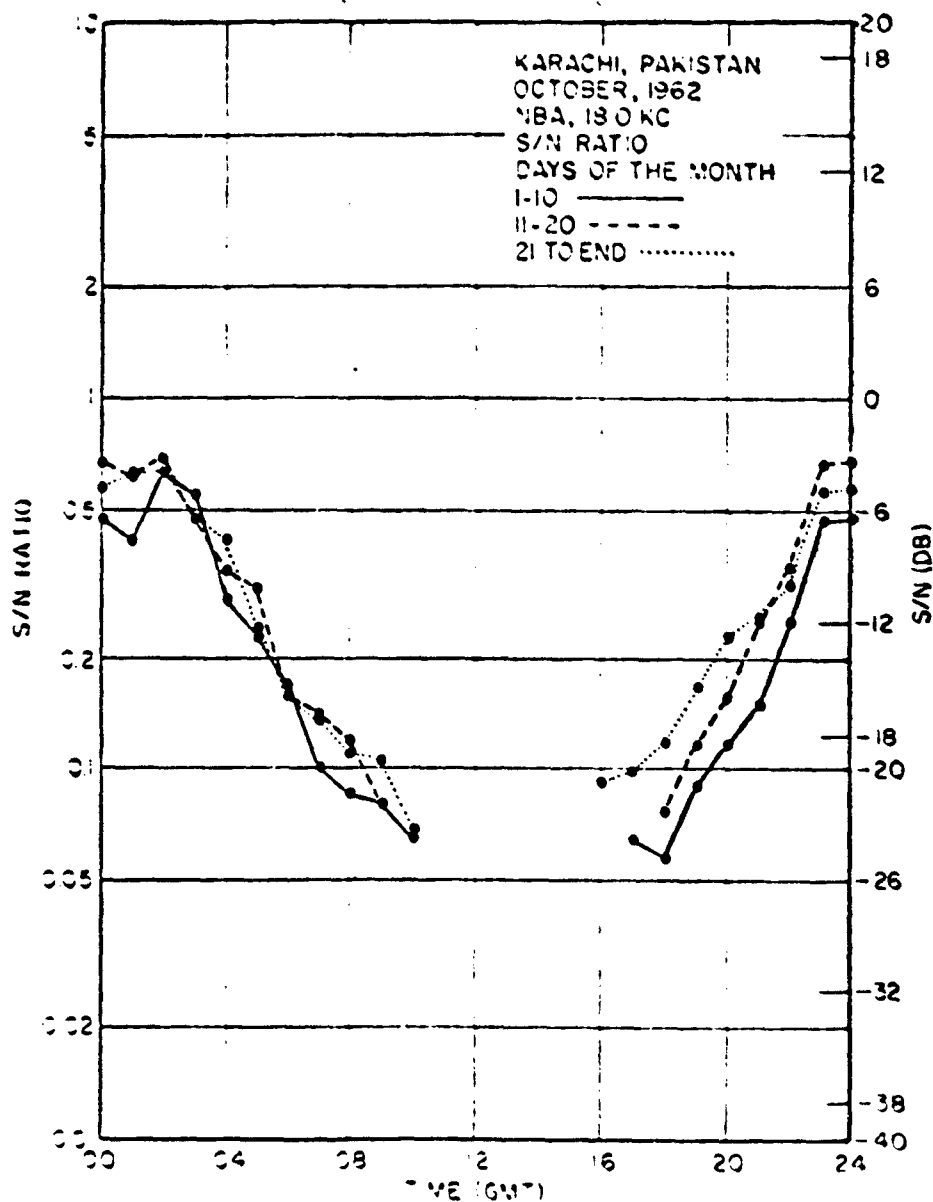


Figure 228

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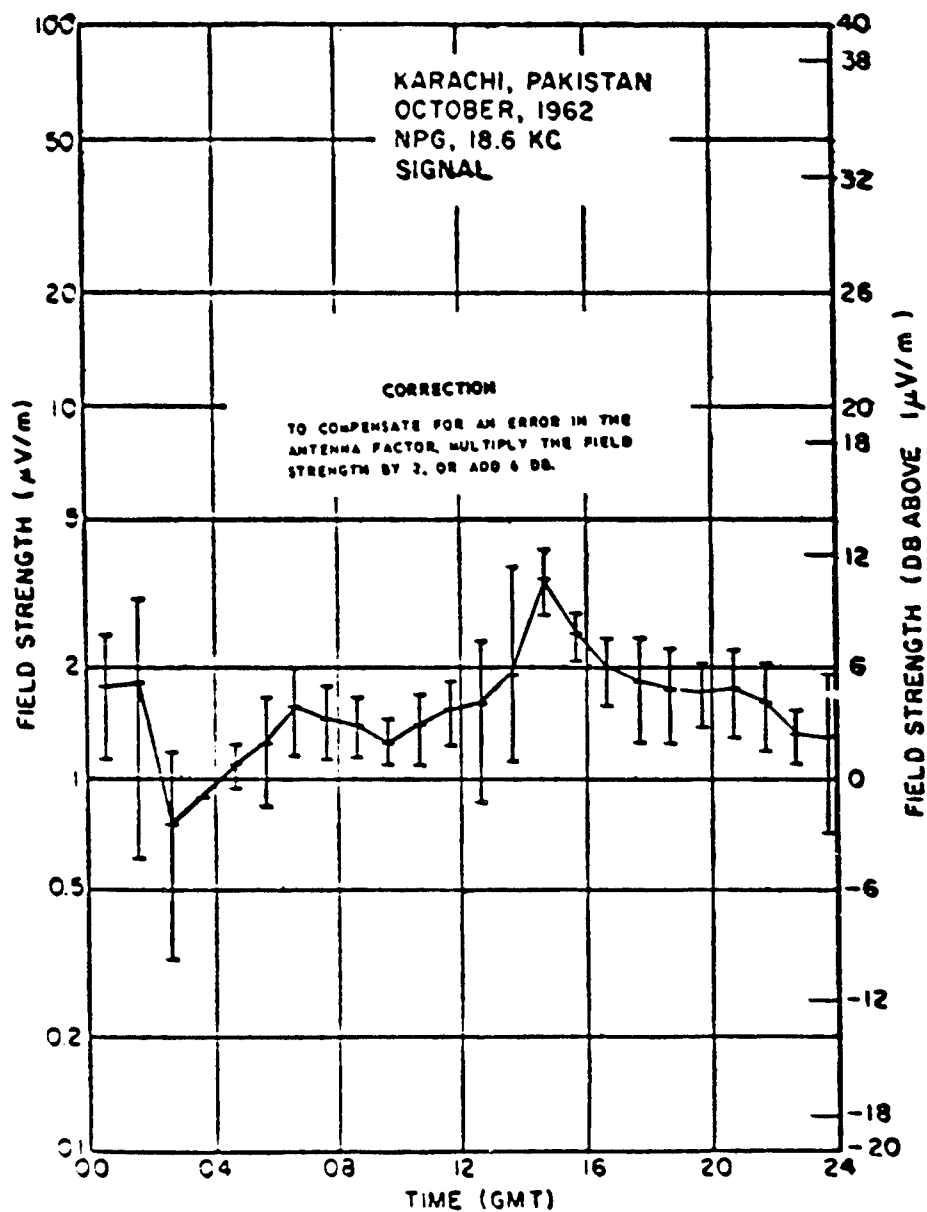


Figure 229

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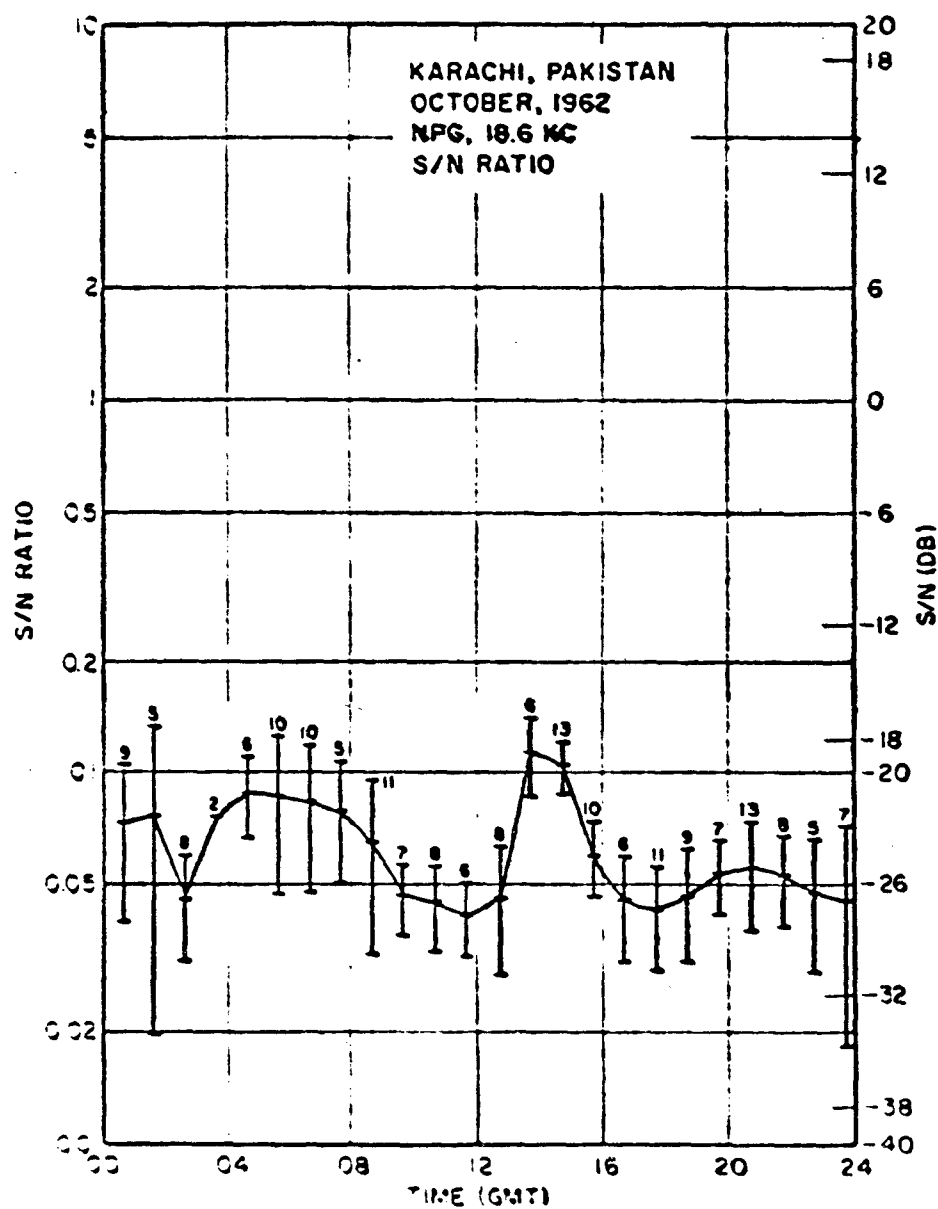


Figure 230

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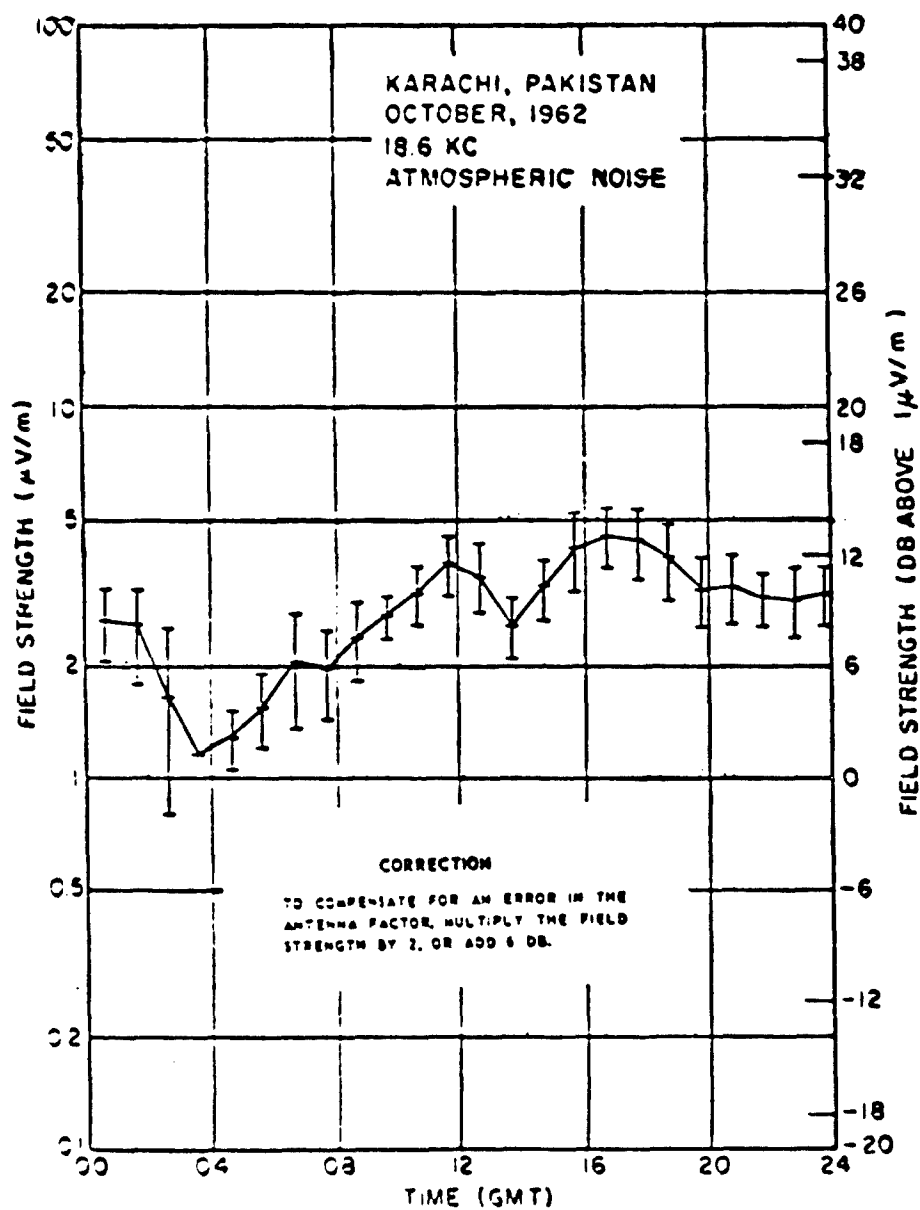


Figure 231

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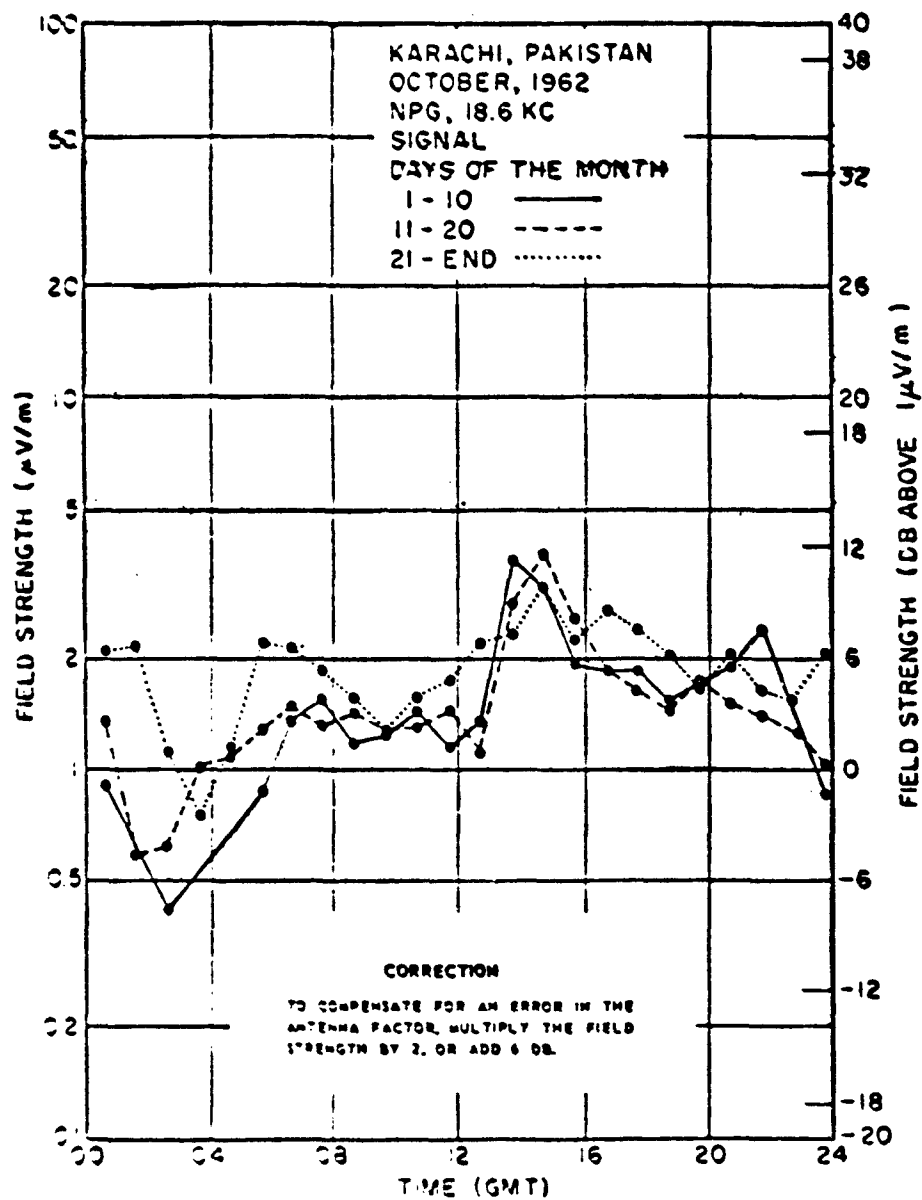


Figure 232

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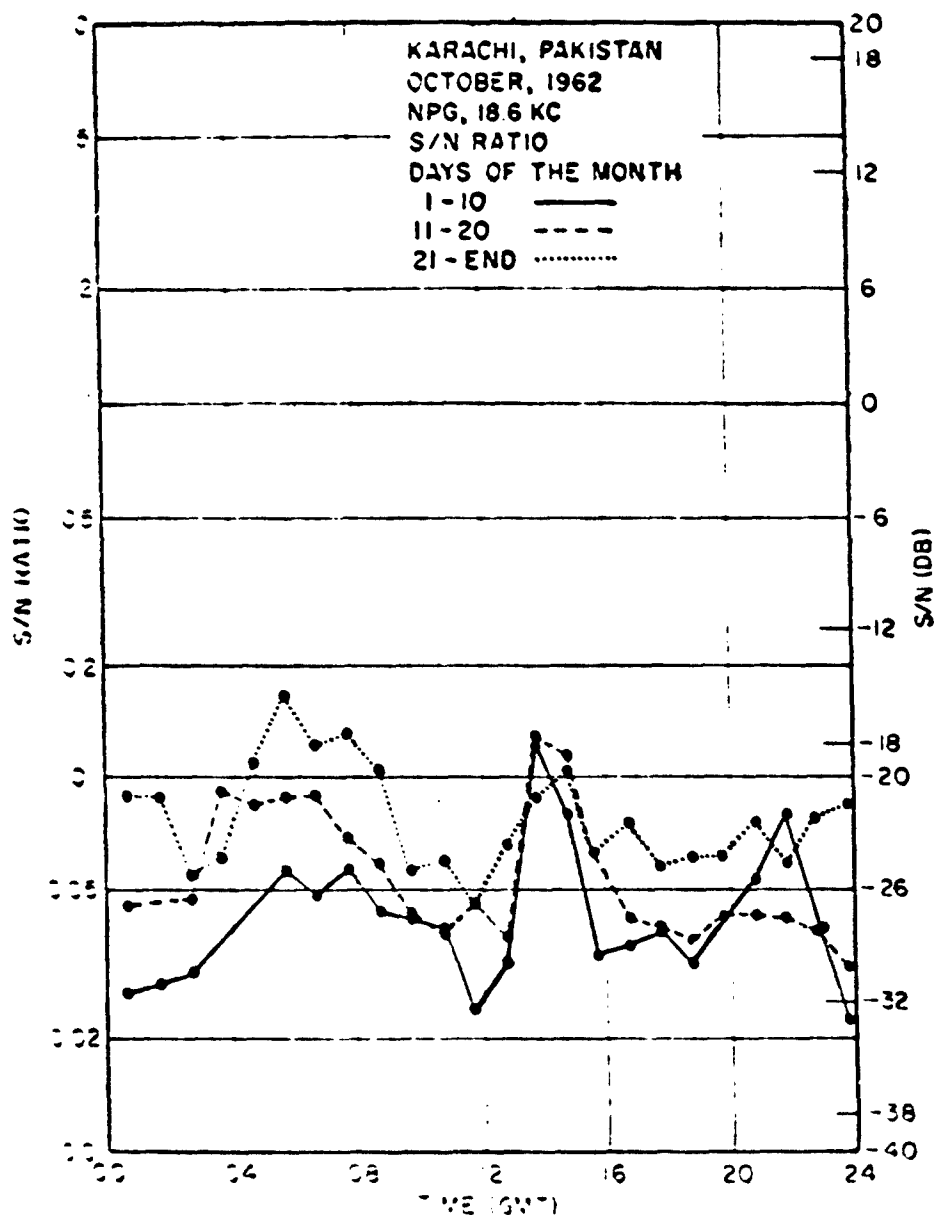


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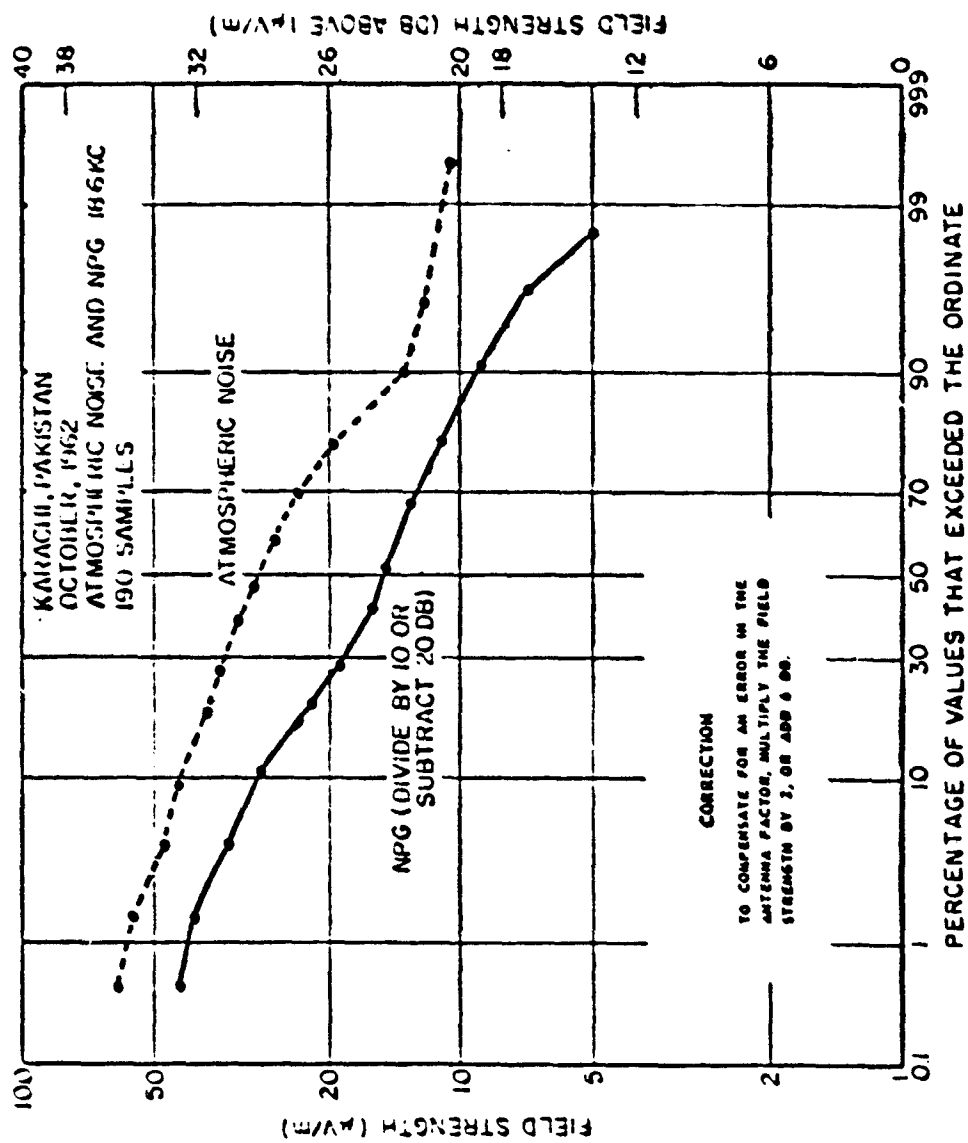


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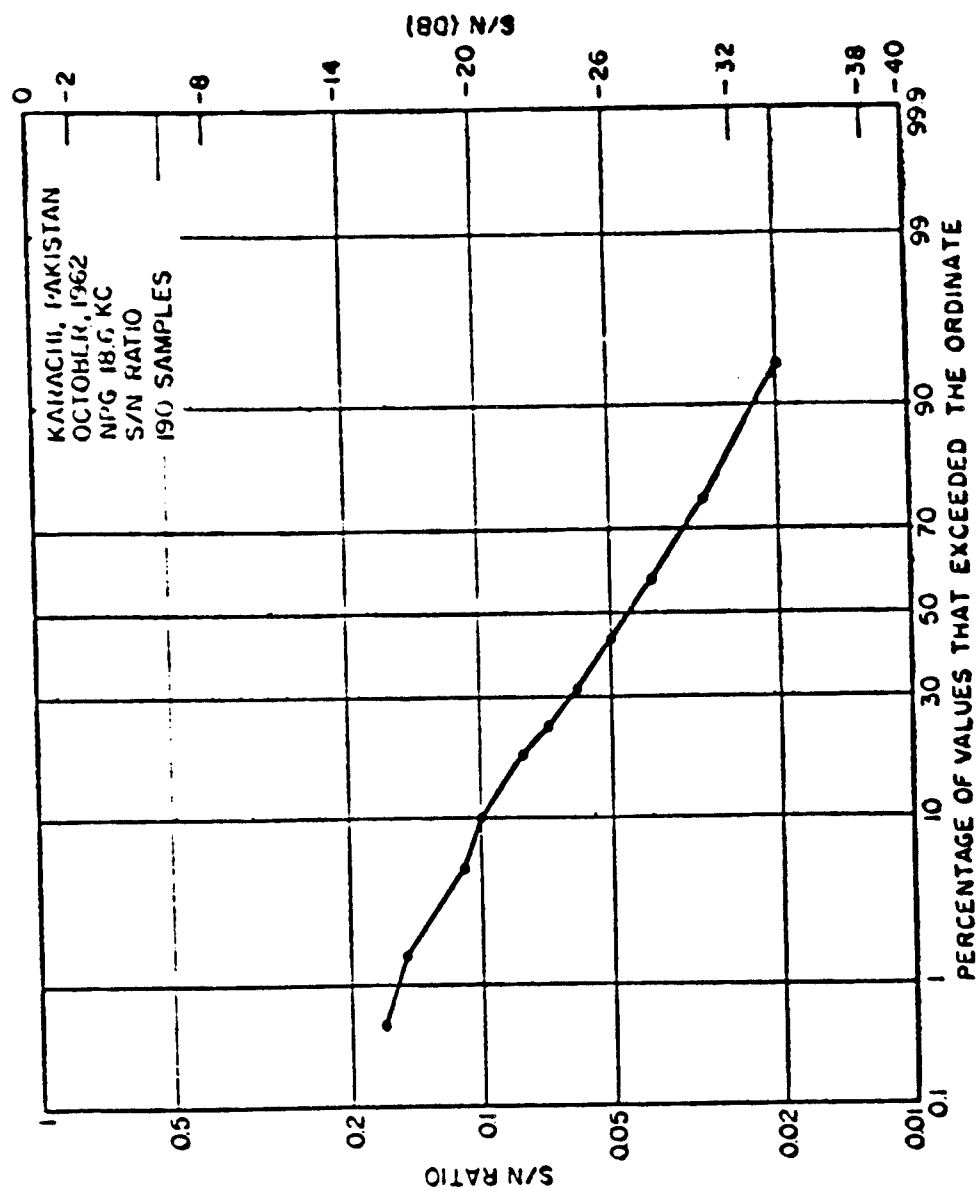


Figure 235

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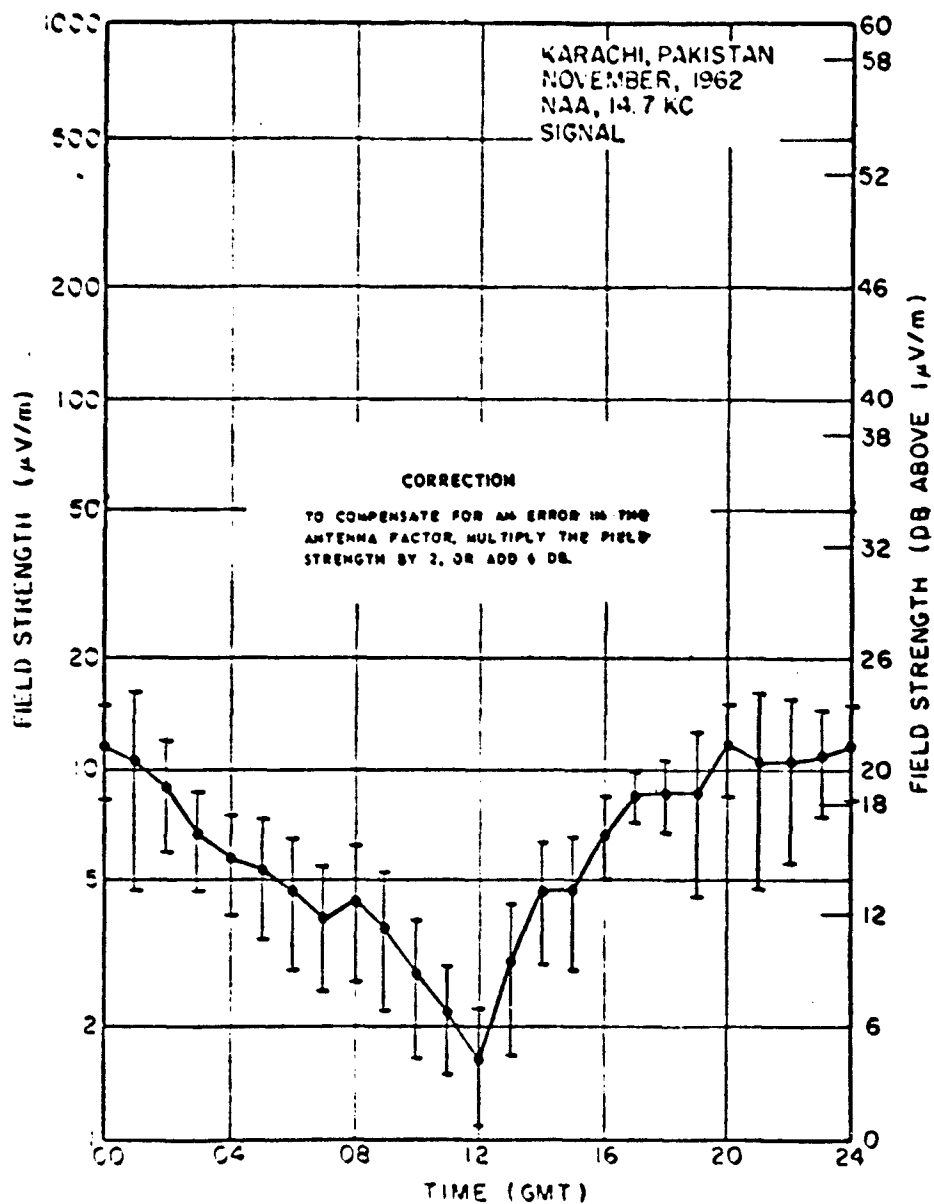


Figure 236

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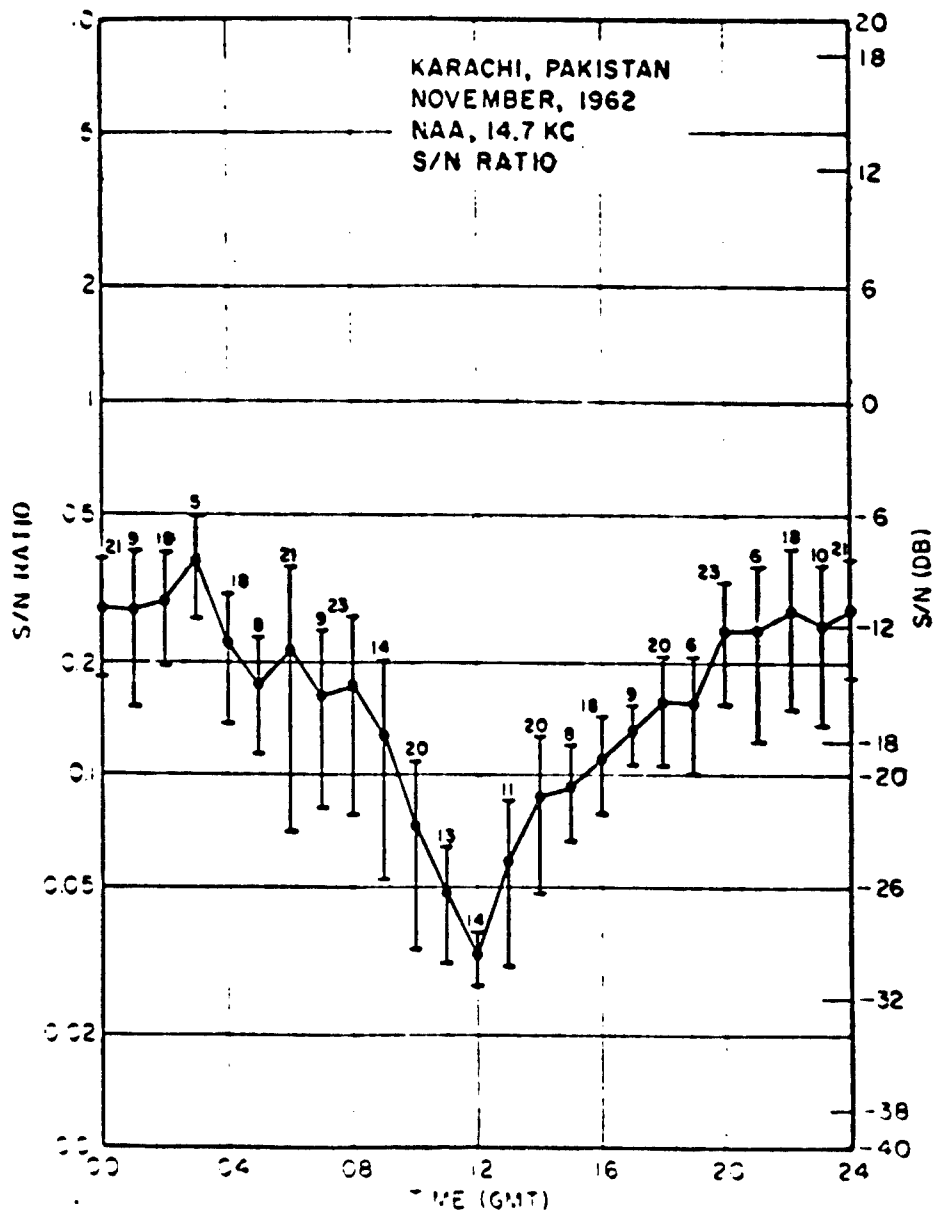


Figure 237

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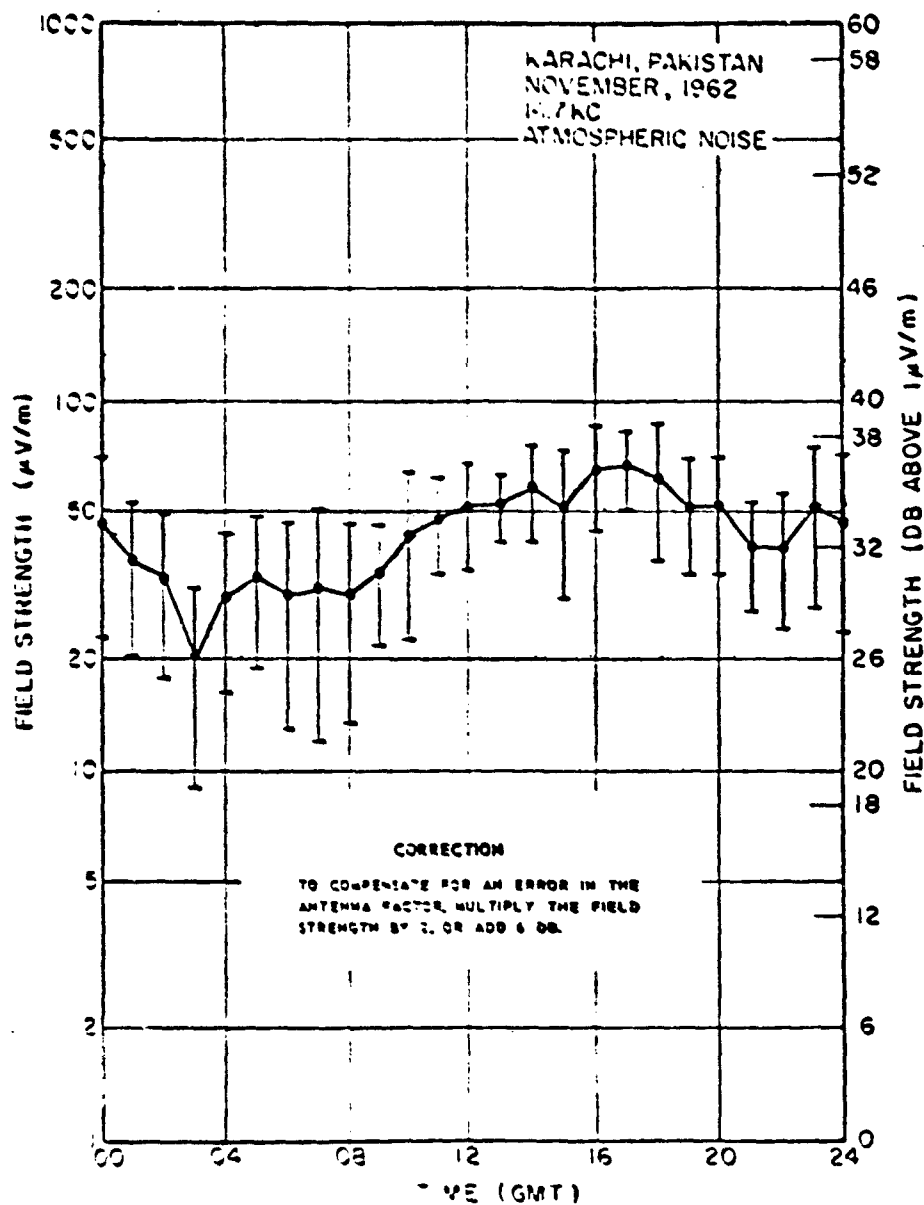


Figure 238

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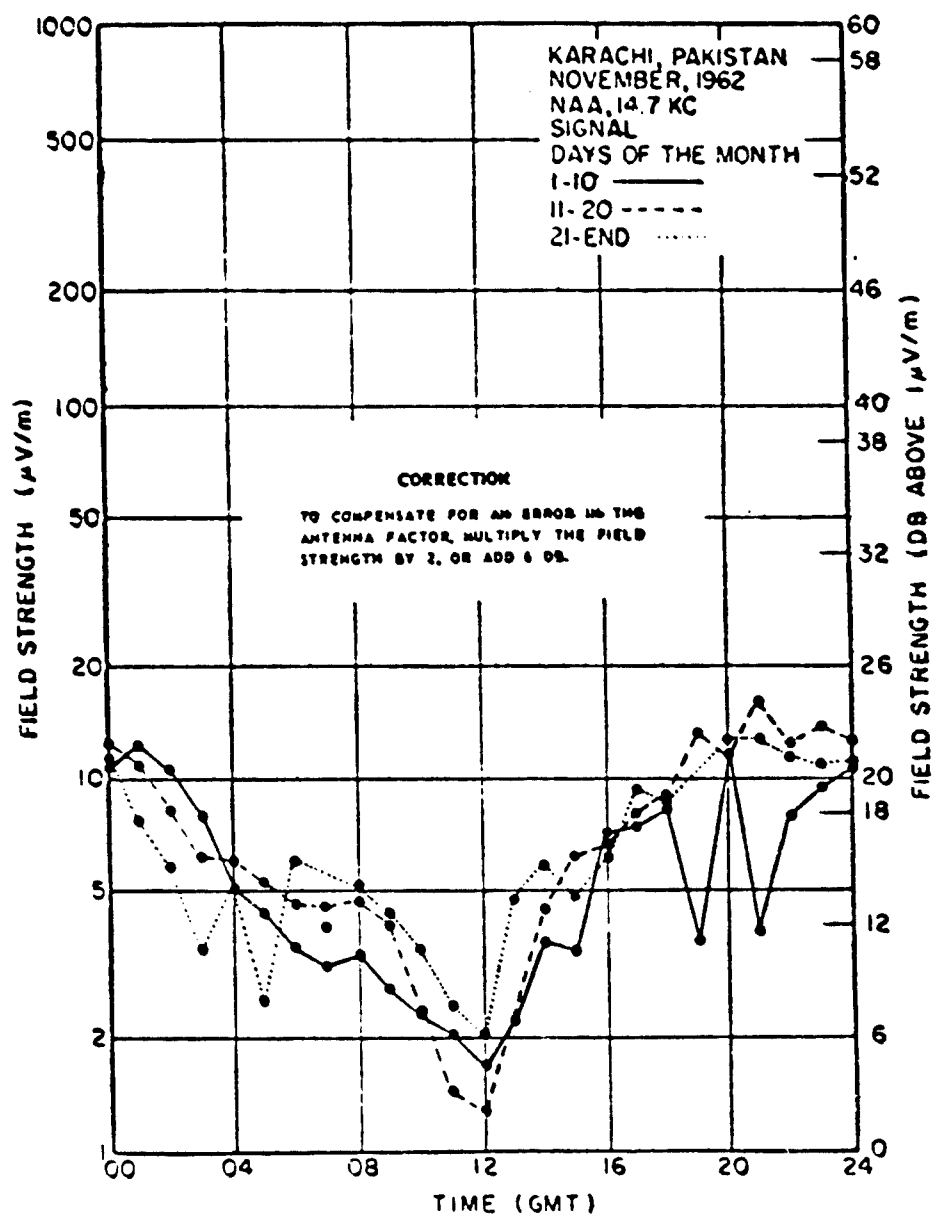


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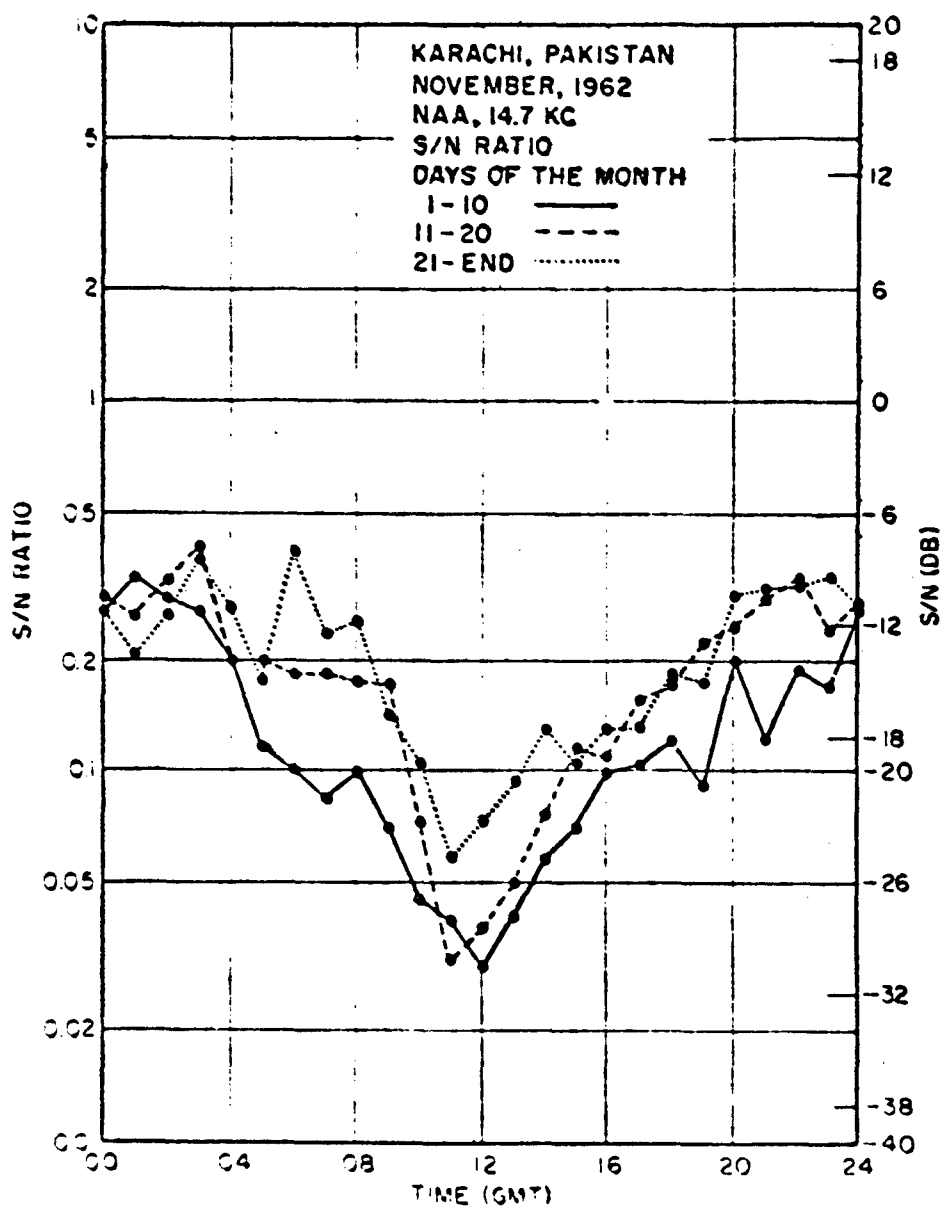


Figure 240

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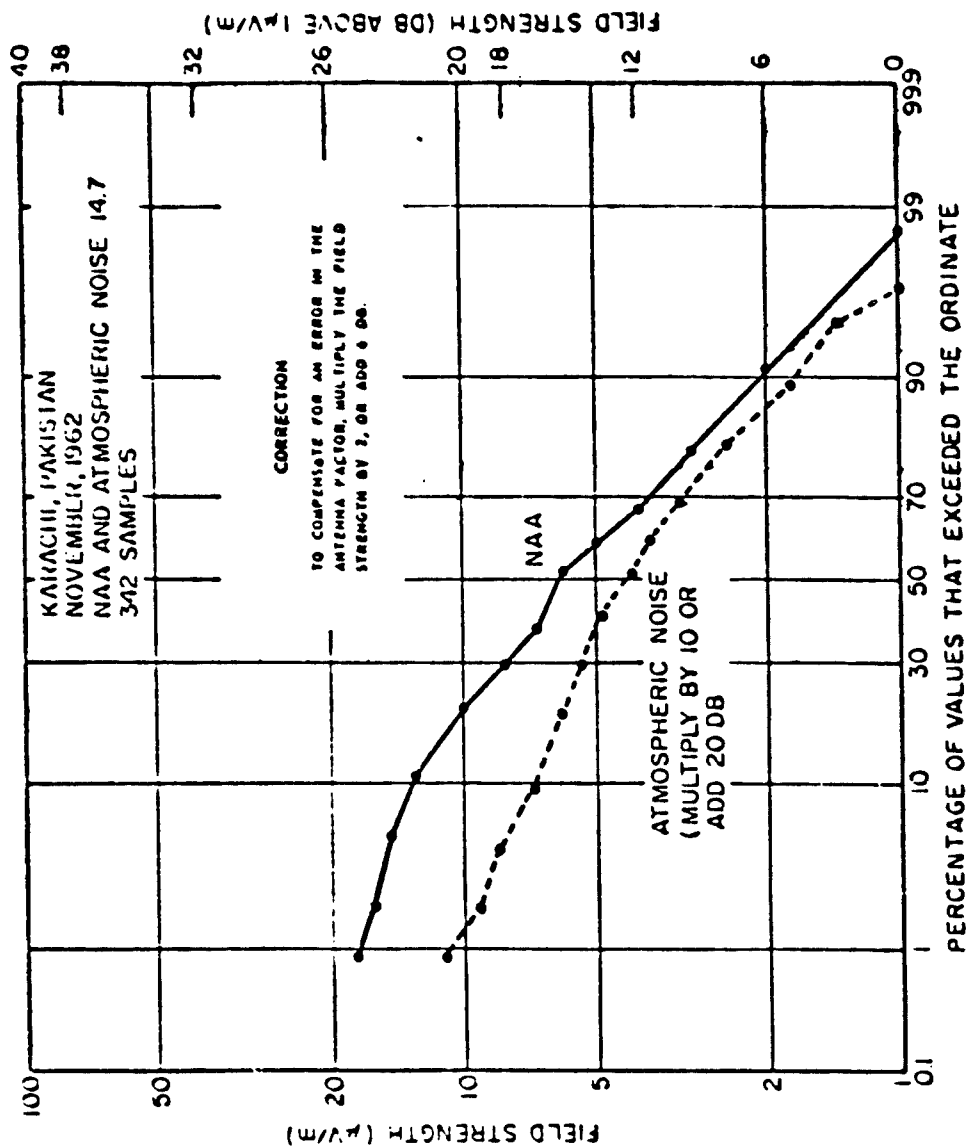


Figure 241

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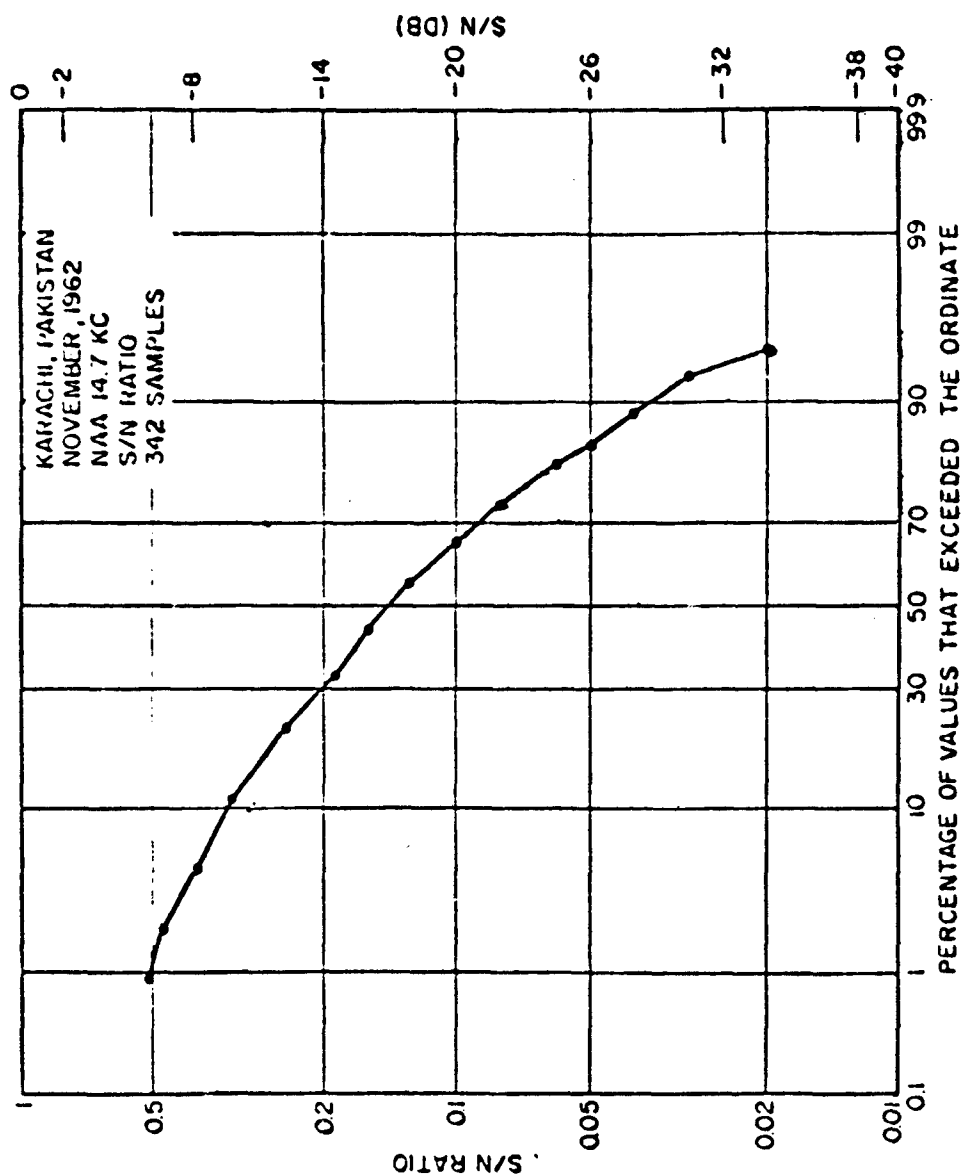


Figure 242

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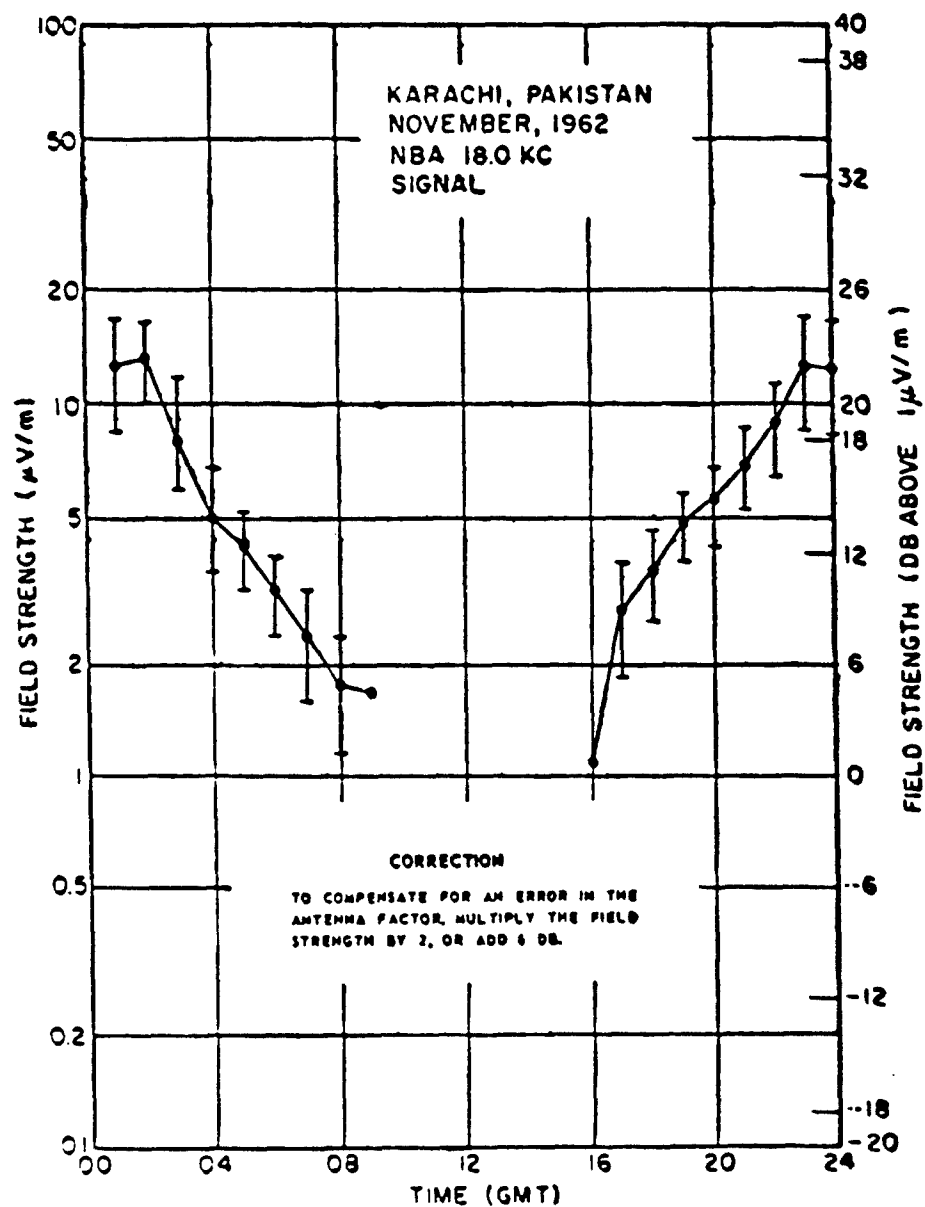


Figure 243

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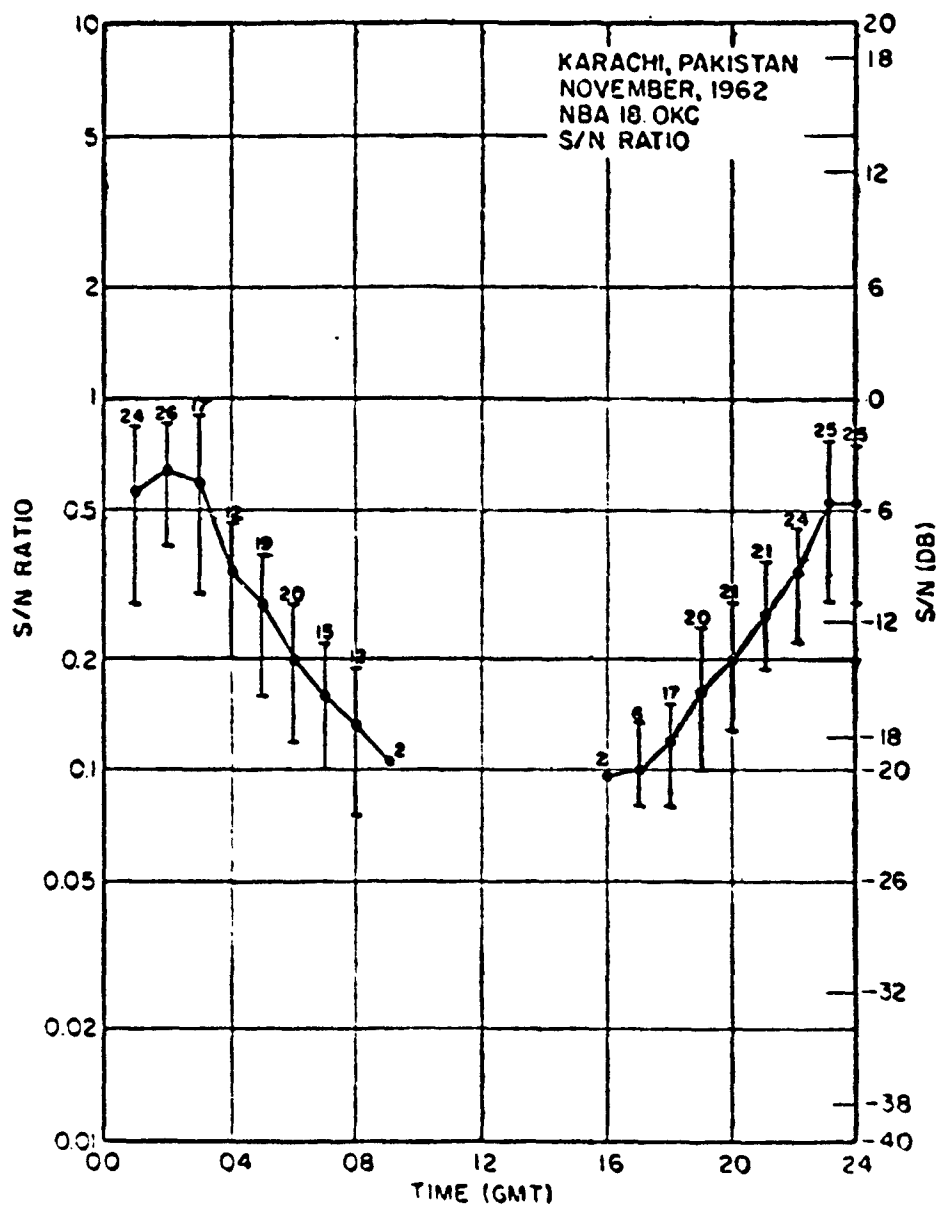


Figure 244

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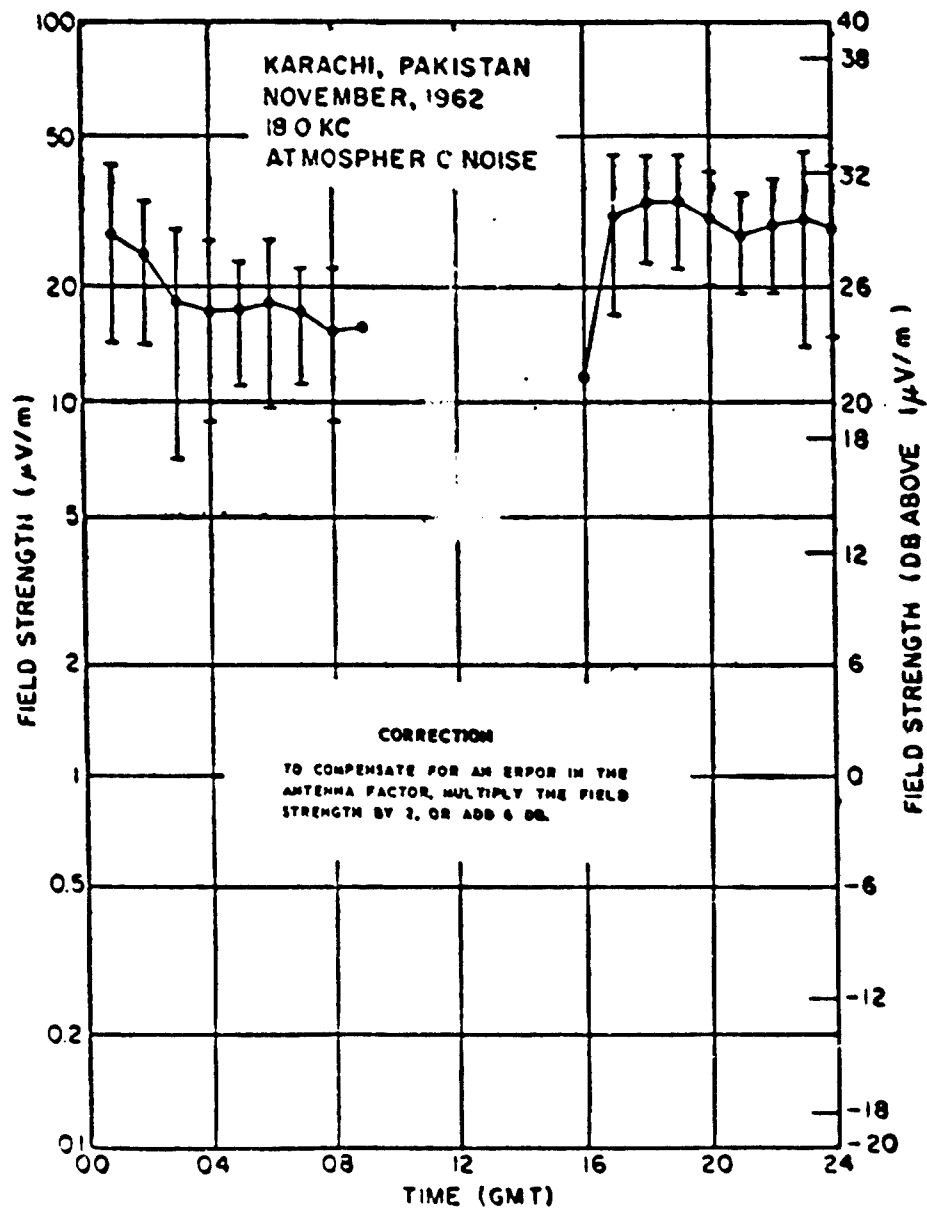


Figure 245

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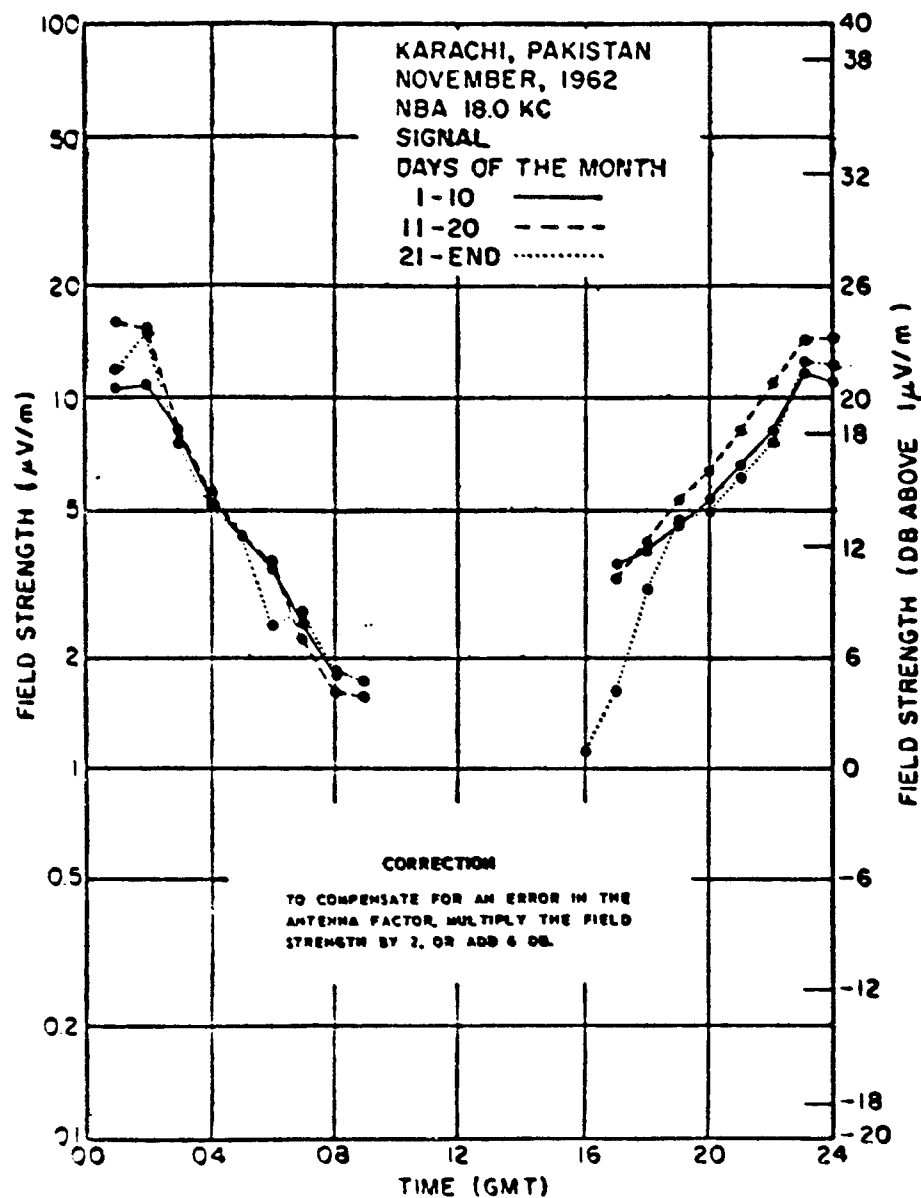


Figure 246

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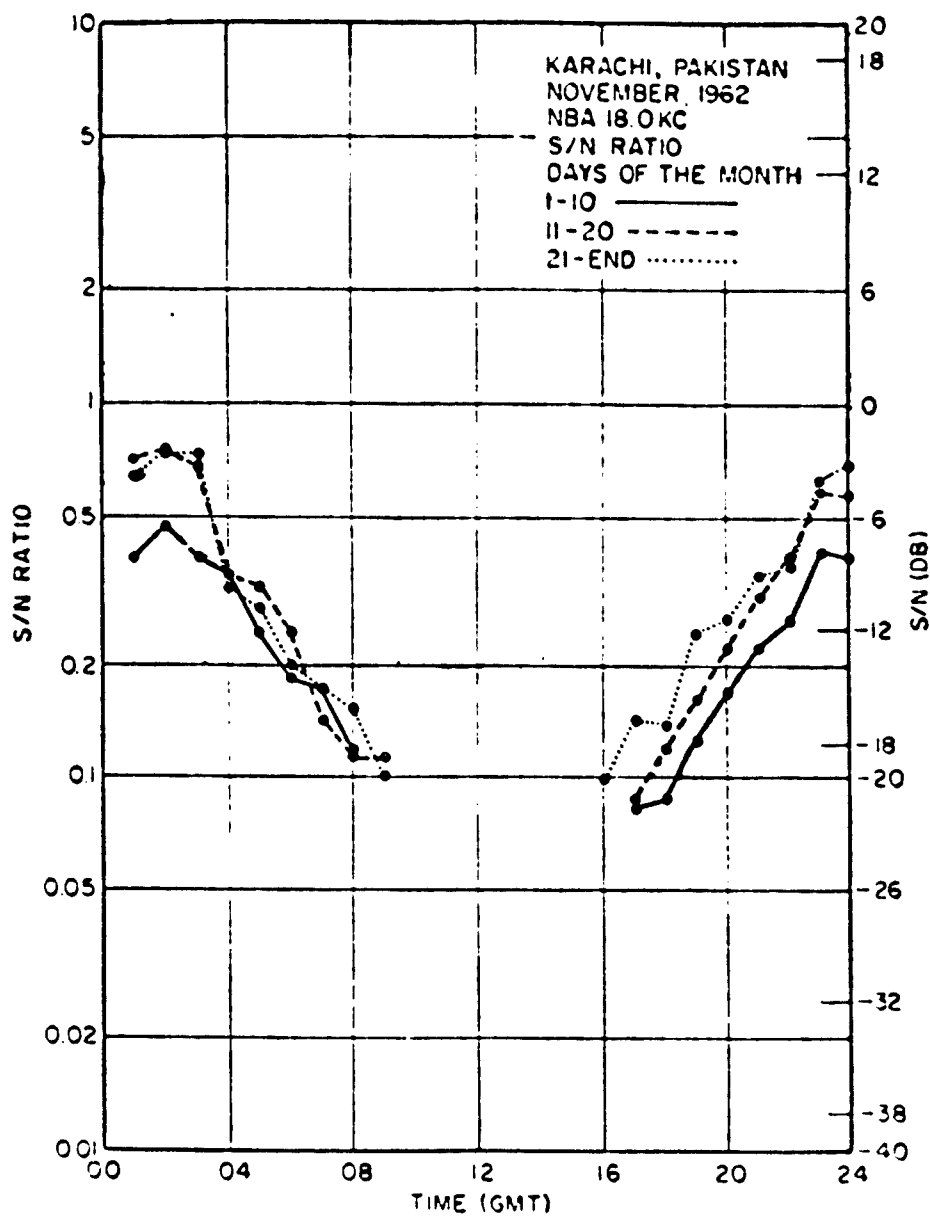


Figure 247

CONFIDENTIAL

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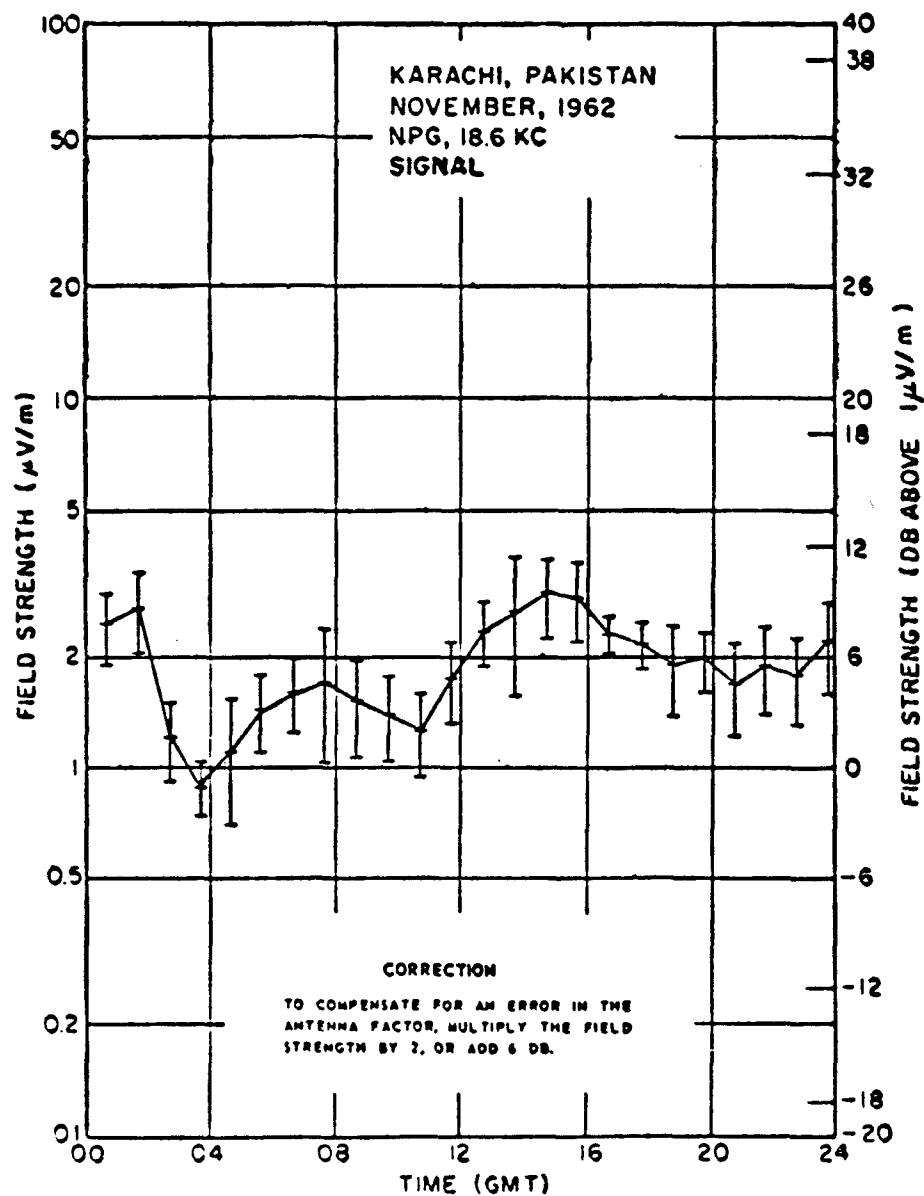


Figure 248

CONFIDENTIAL

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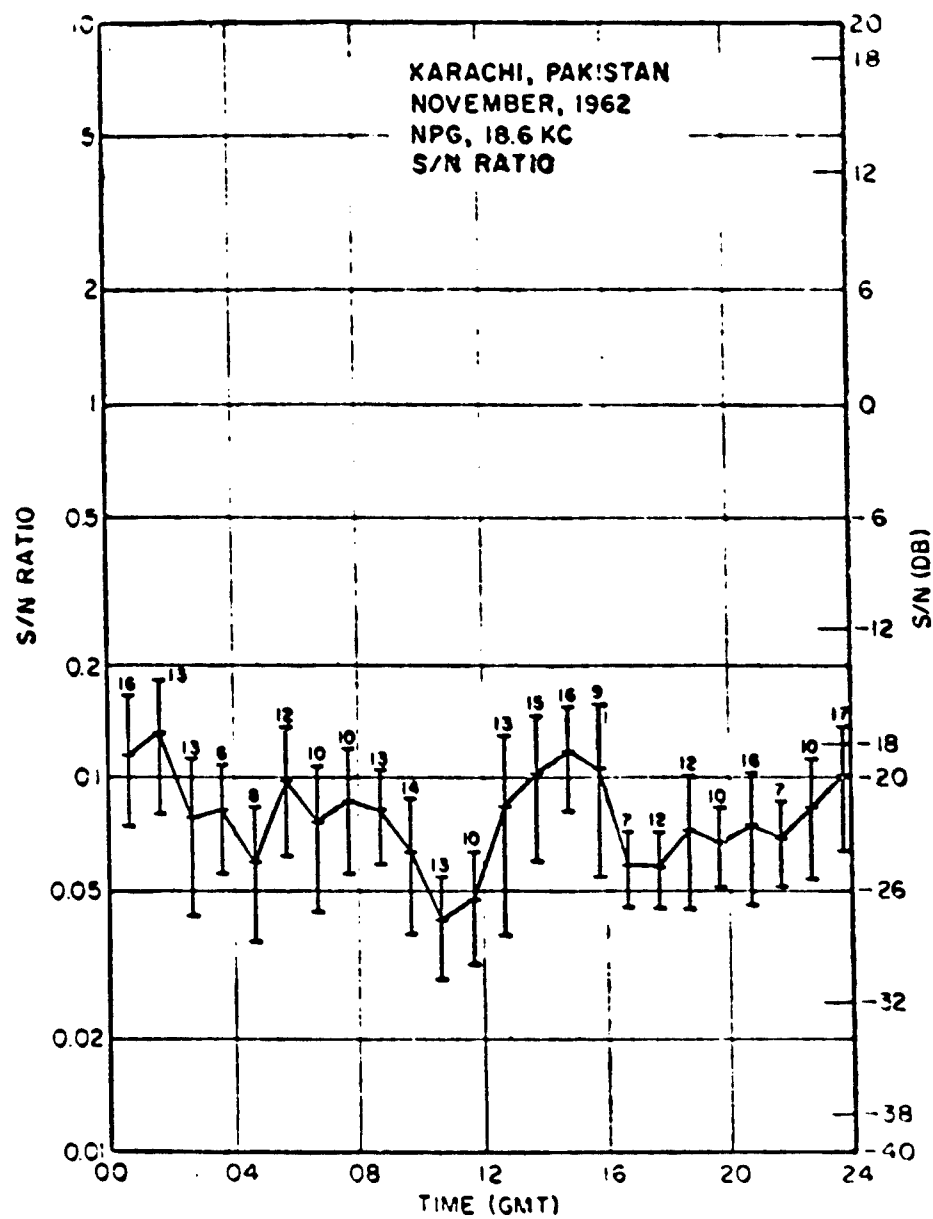


Figure 269

CONFIDENTIAL

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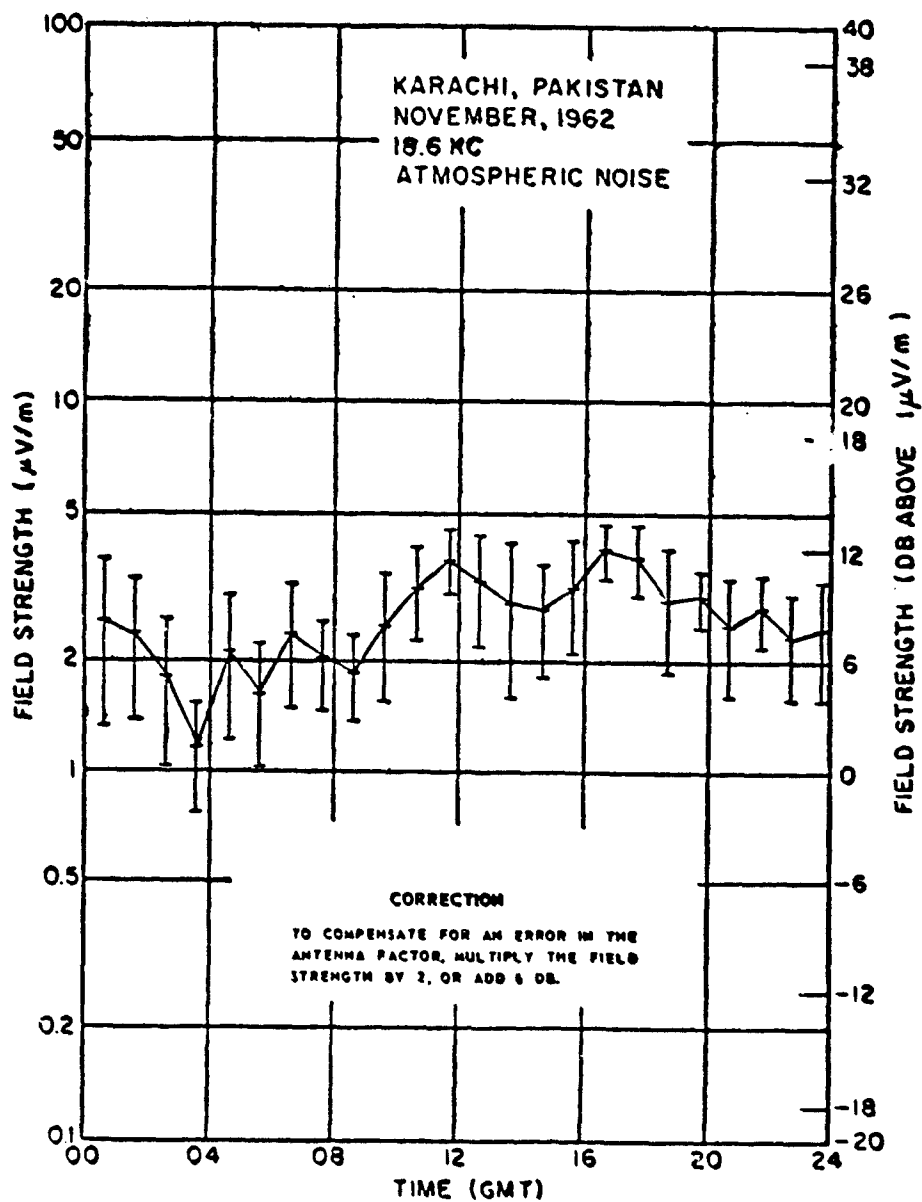


Figure 250

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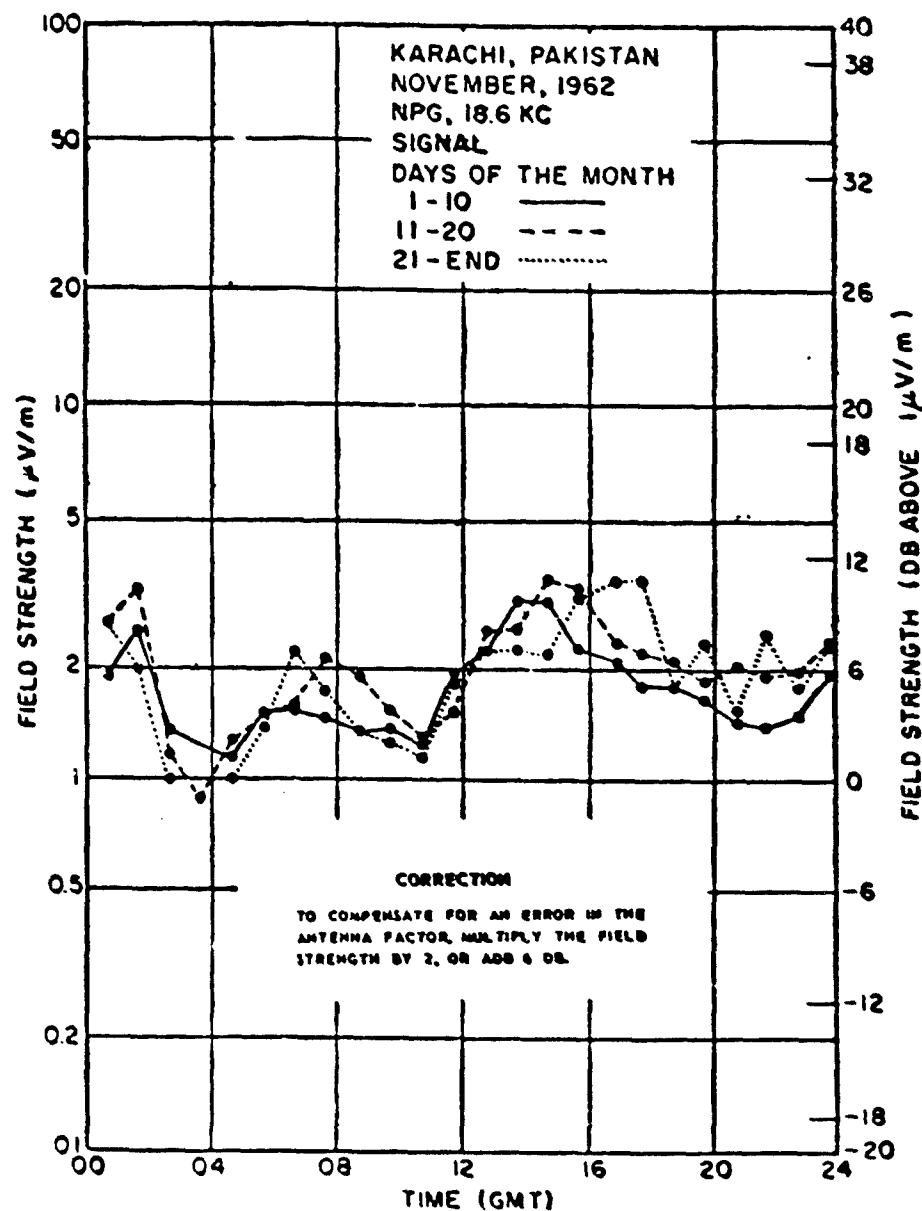


Figure 251

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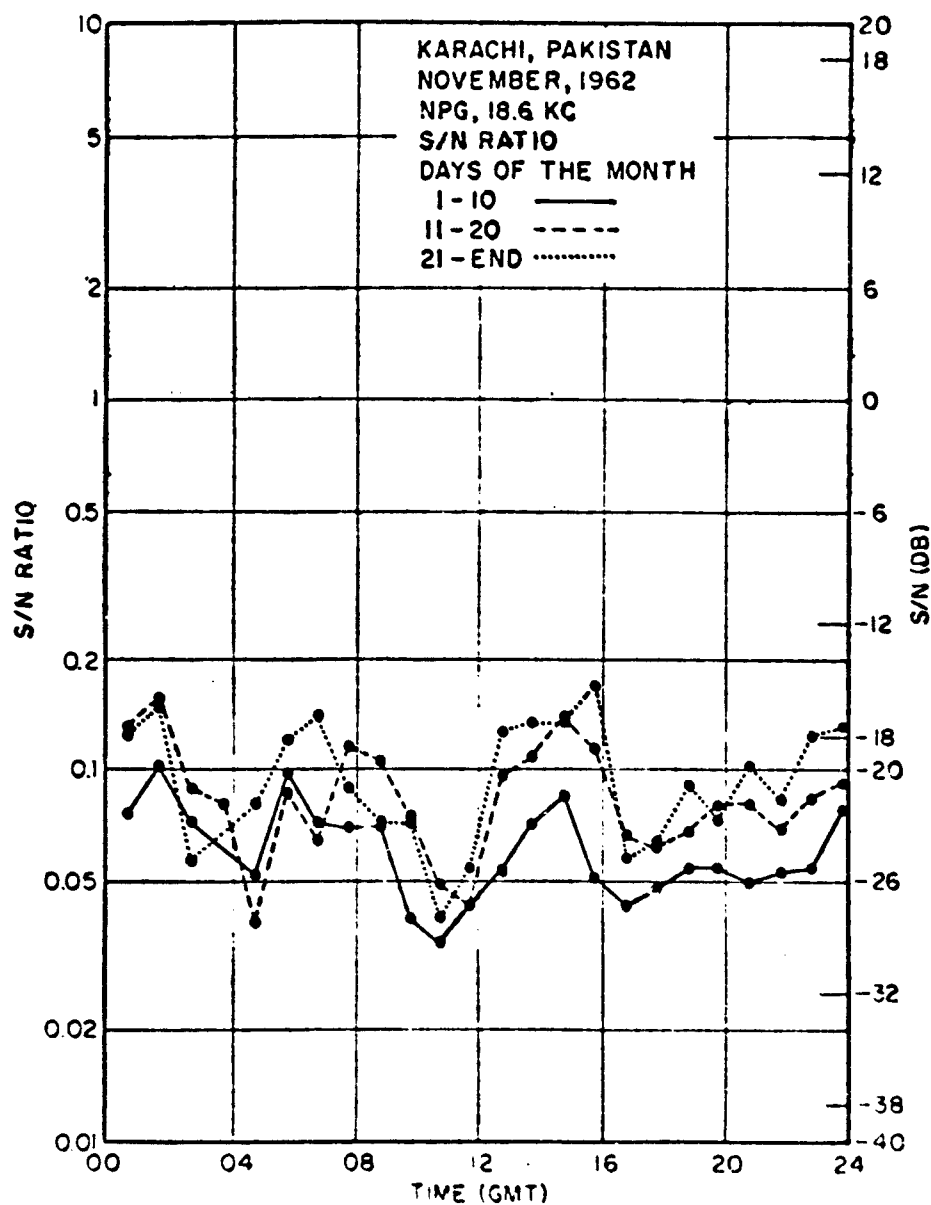


Figure 252

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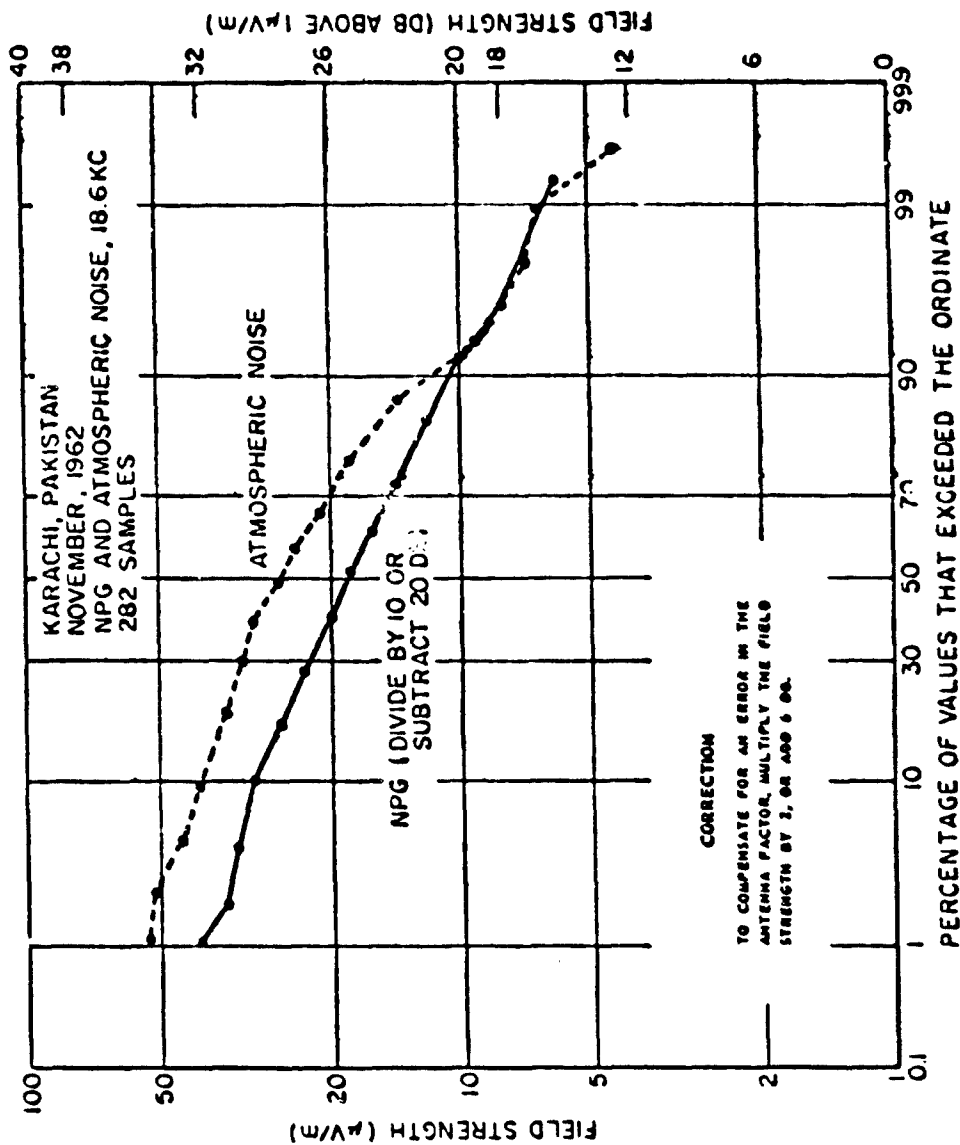


Figure 253

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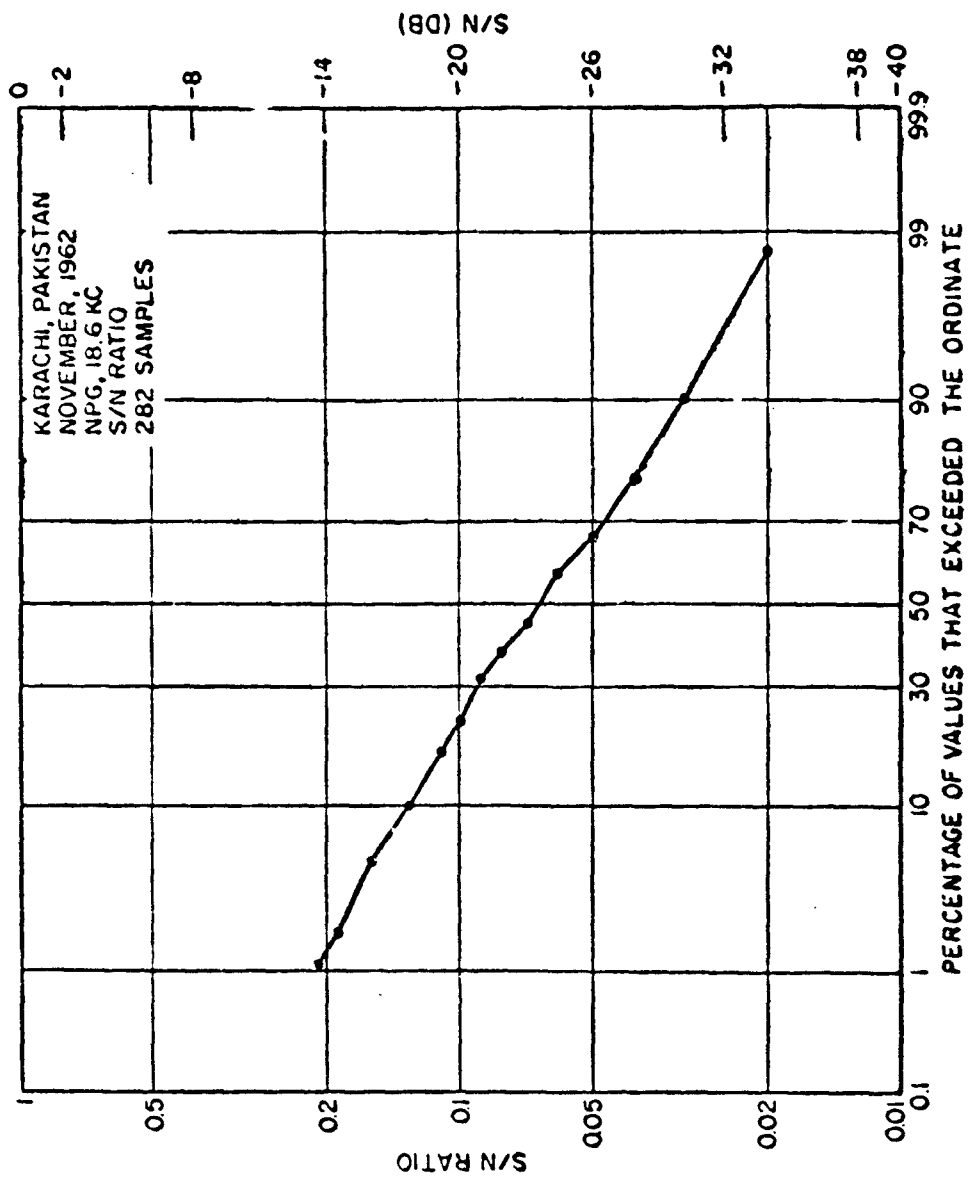


Figure 254

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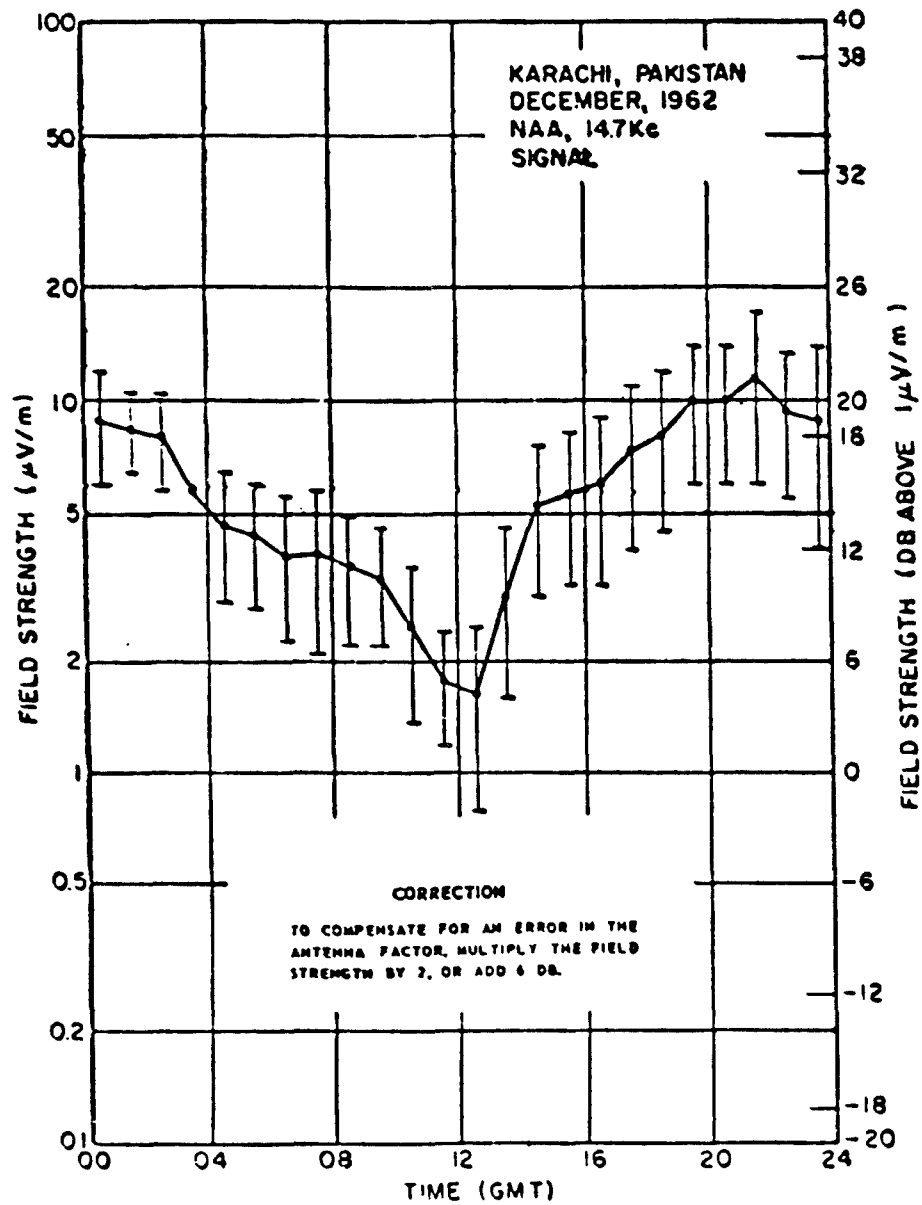


Figure 255

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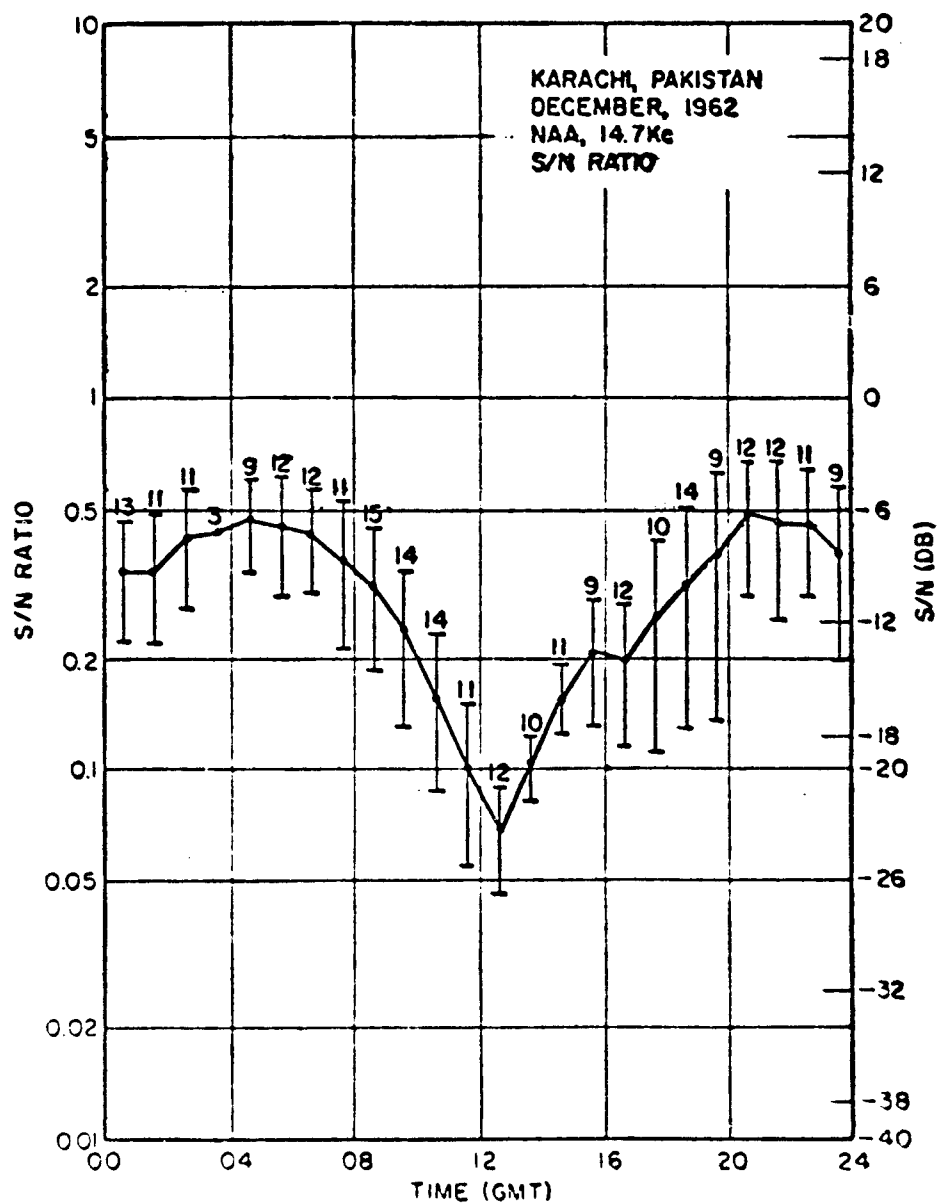


Figure 256

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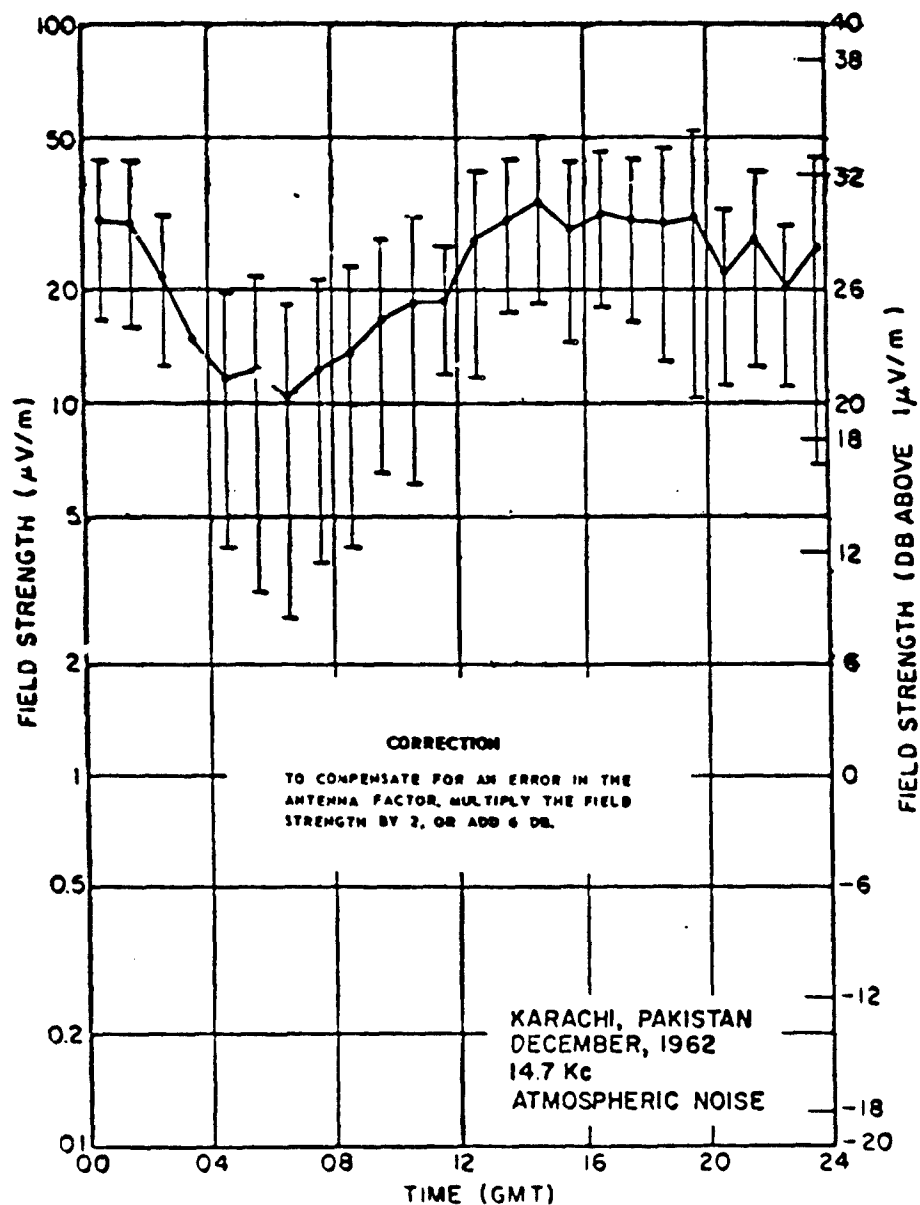


Figure 257

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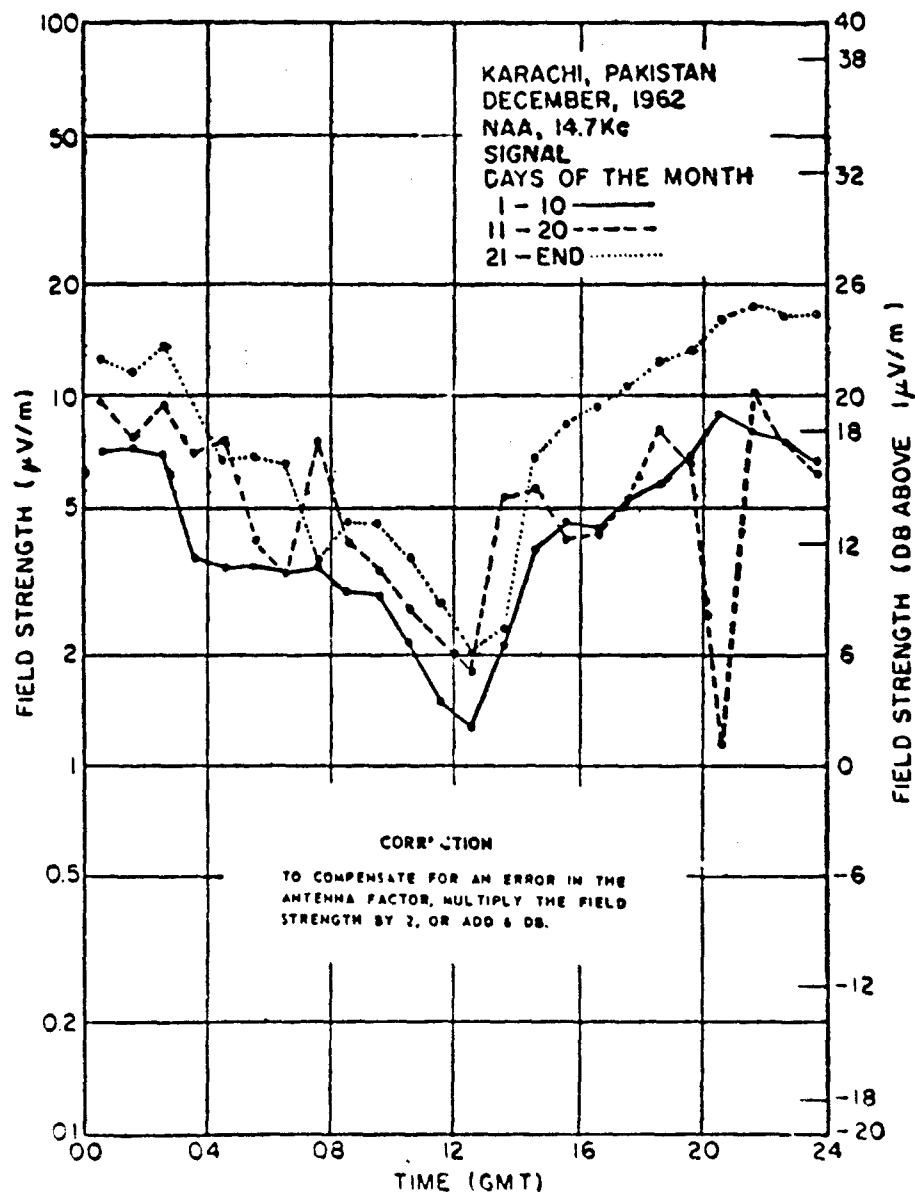


Figure 258

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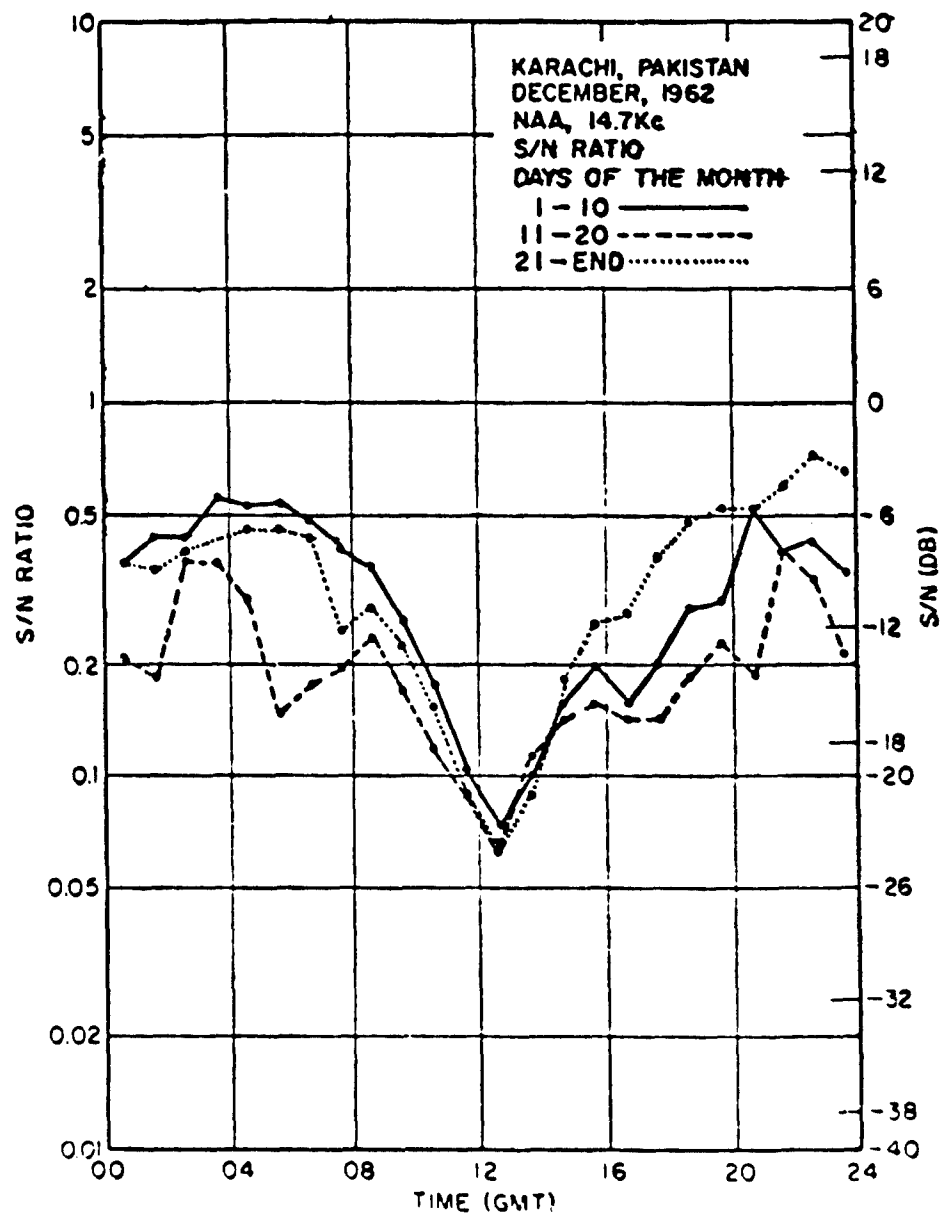


Figure 259

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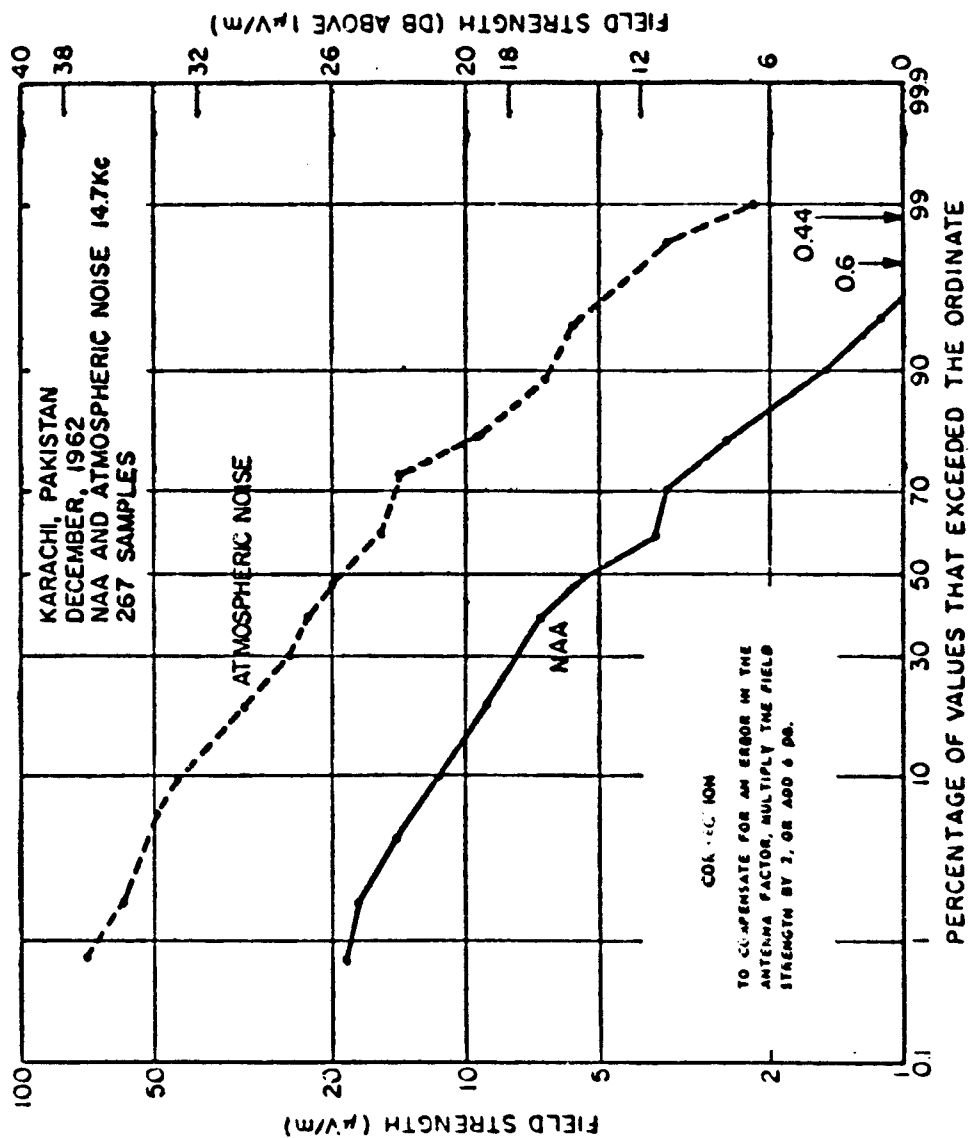


Figure 260

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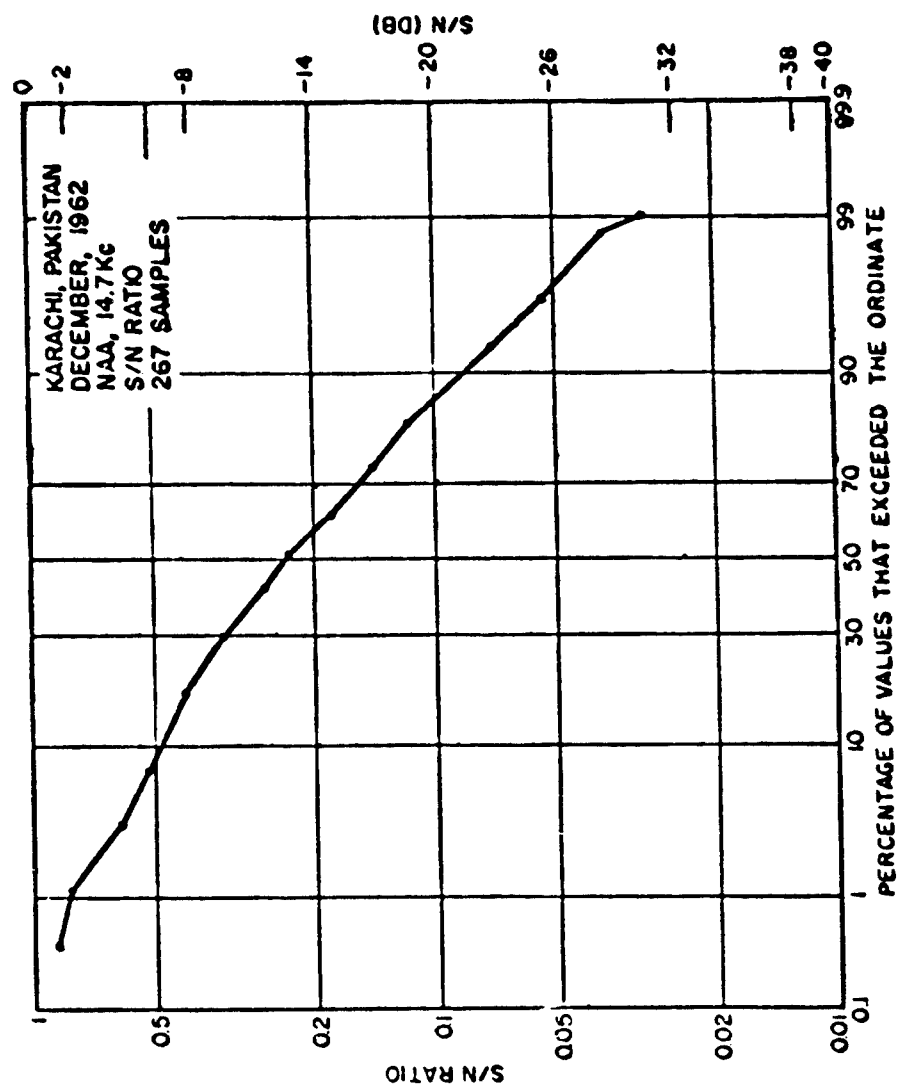


Figure 261

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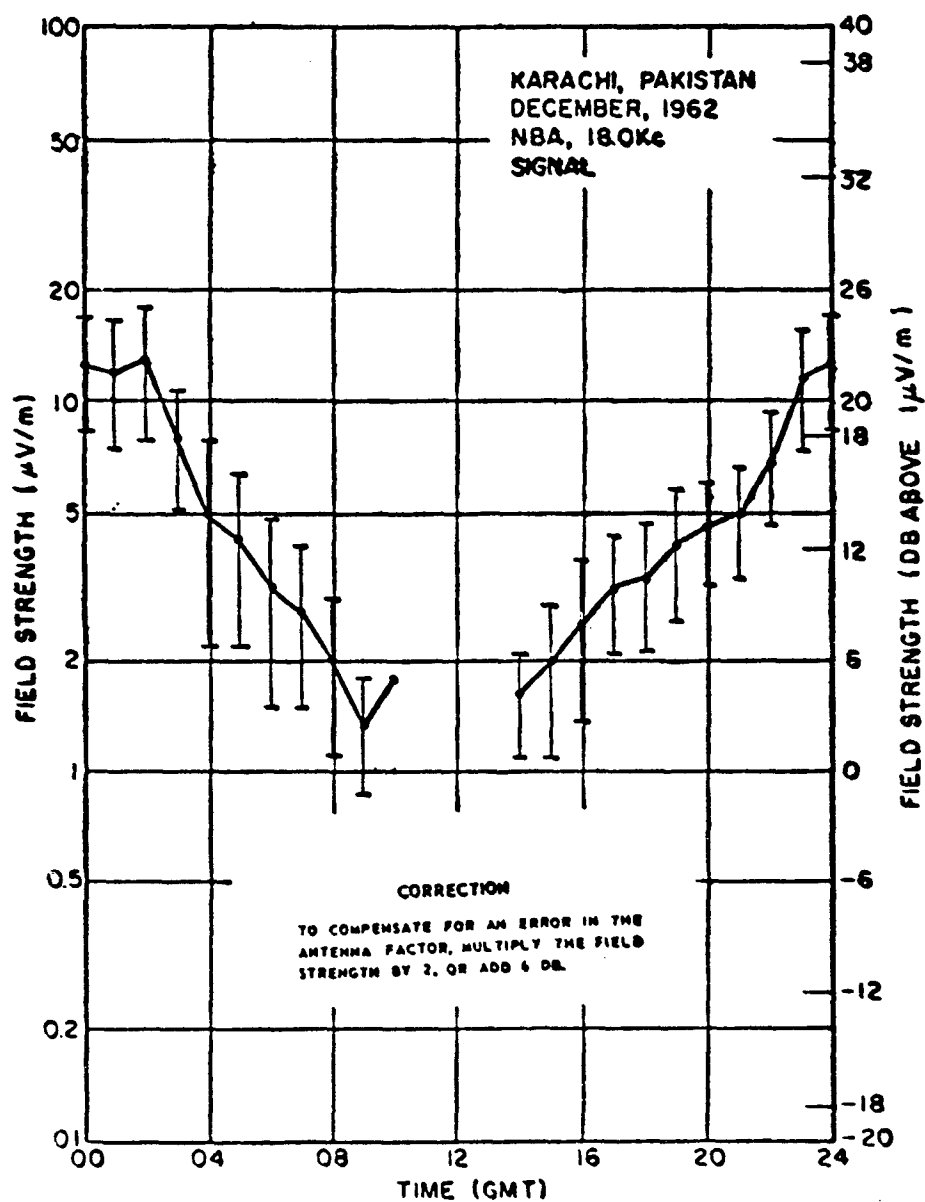


Figure 262

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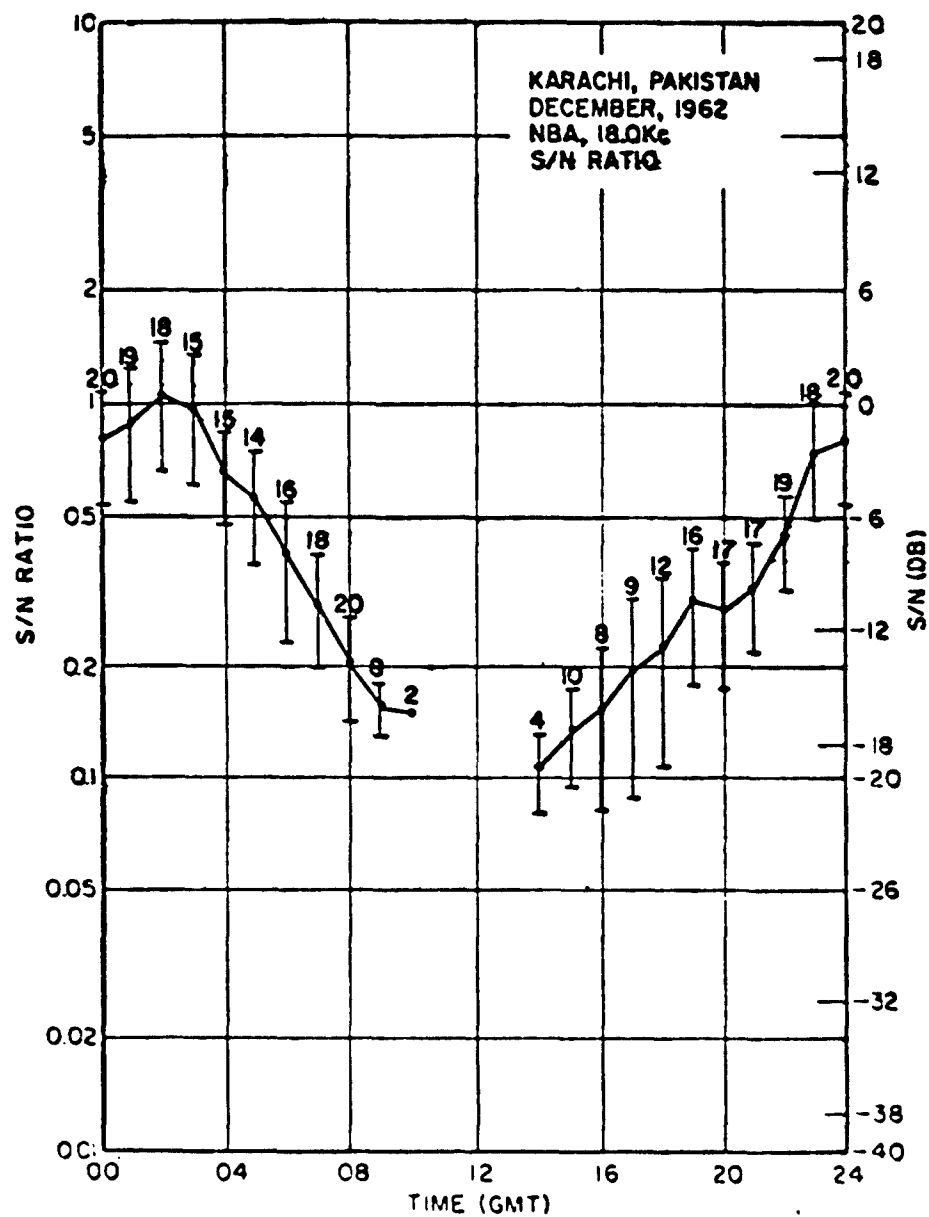


Figure 263

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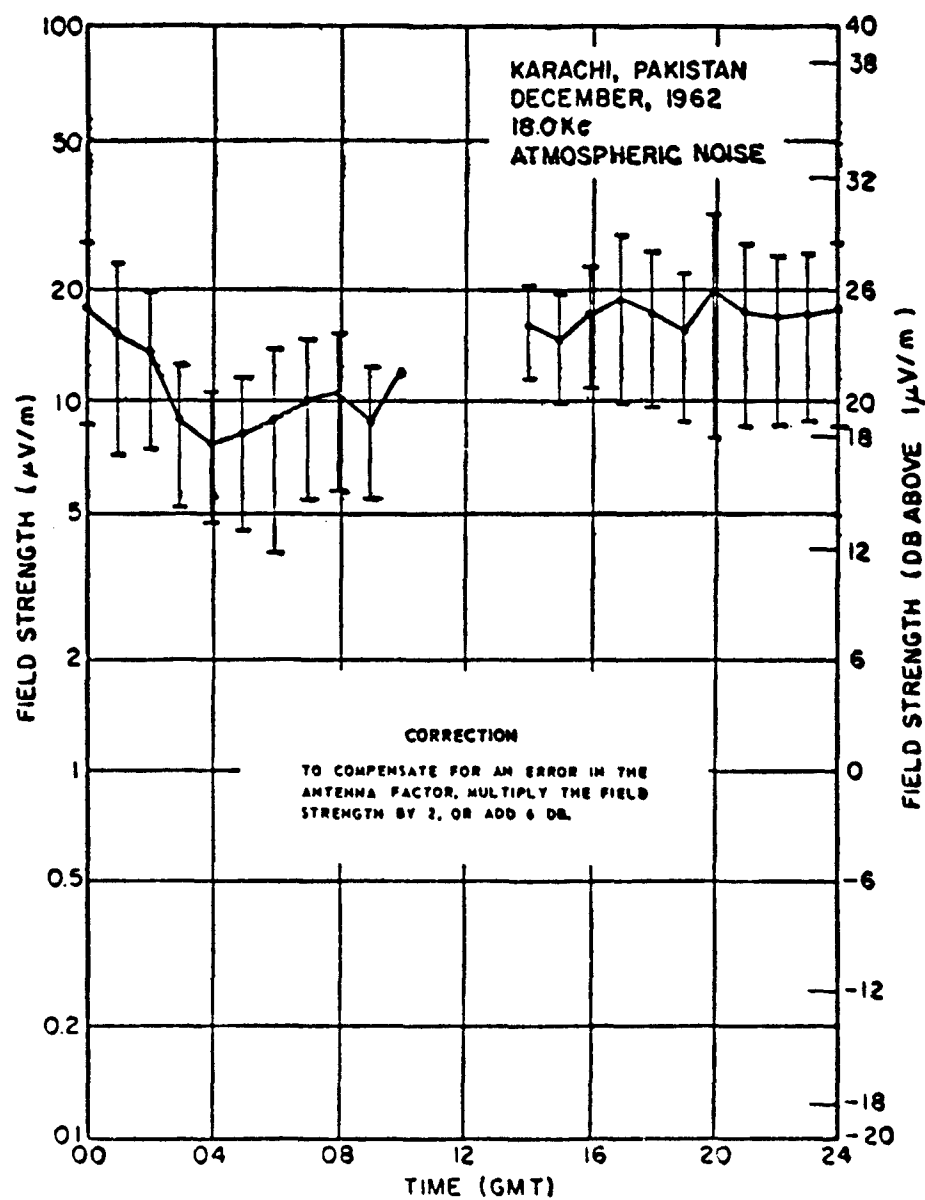


Figure 264

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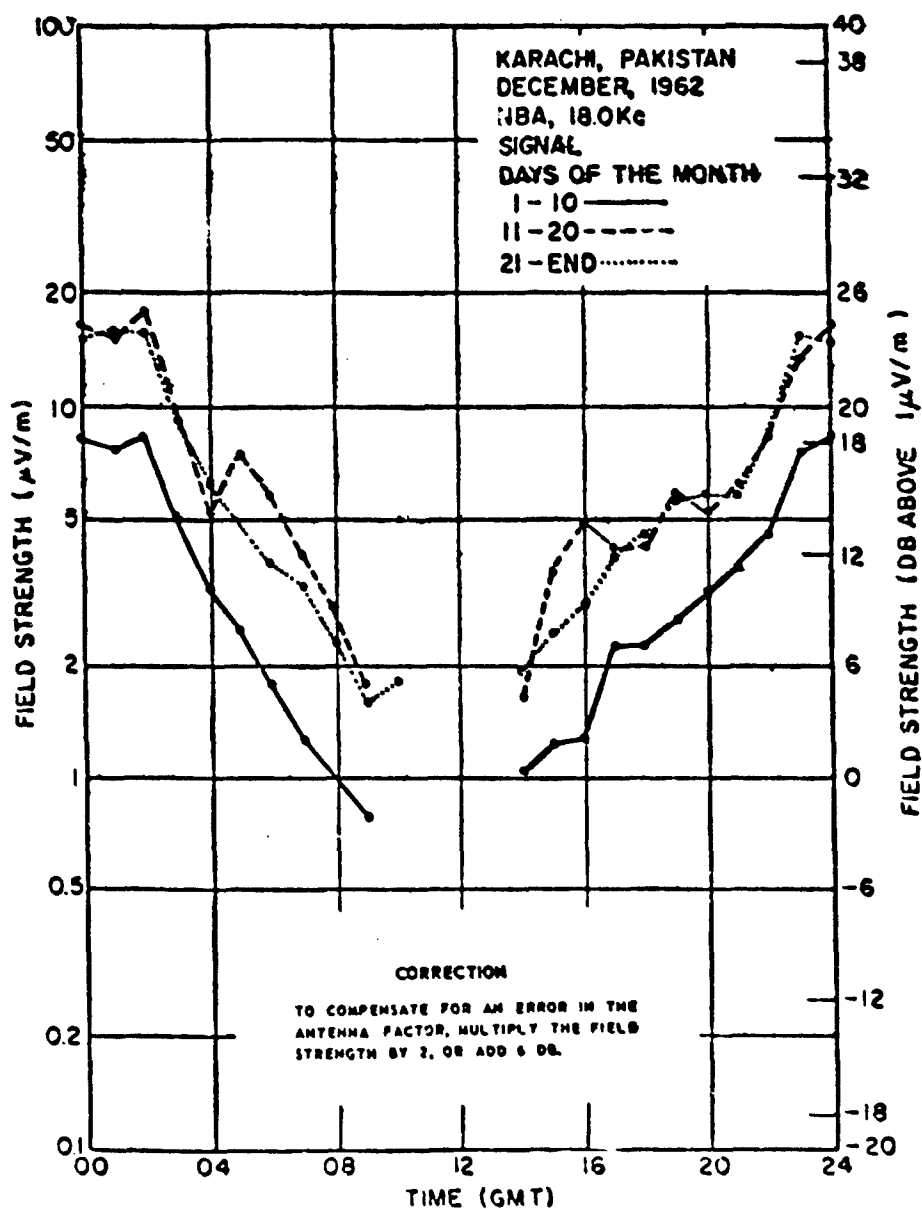


Figure 265

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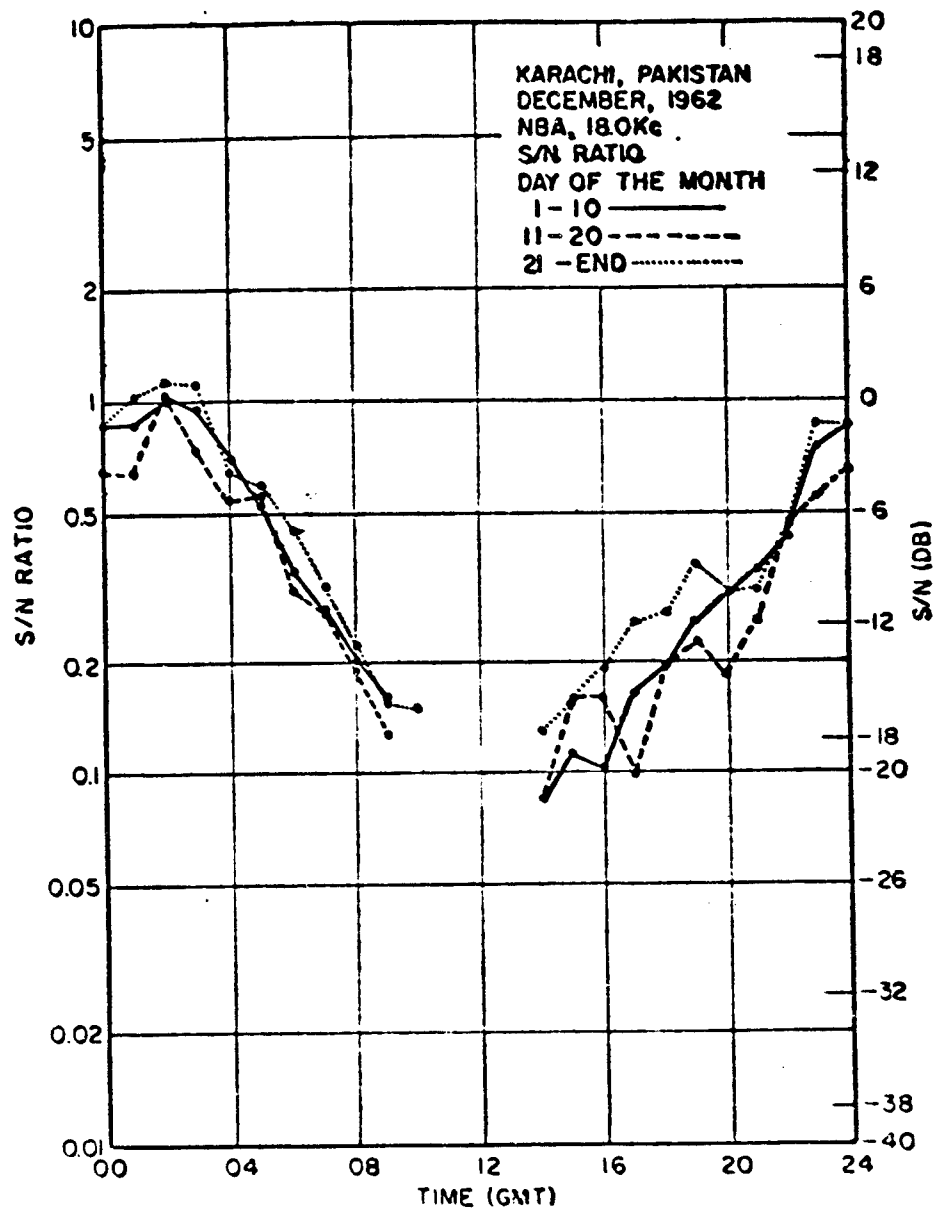


Figure 26a

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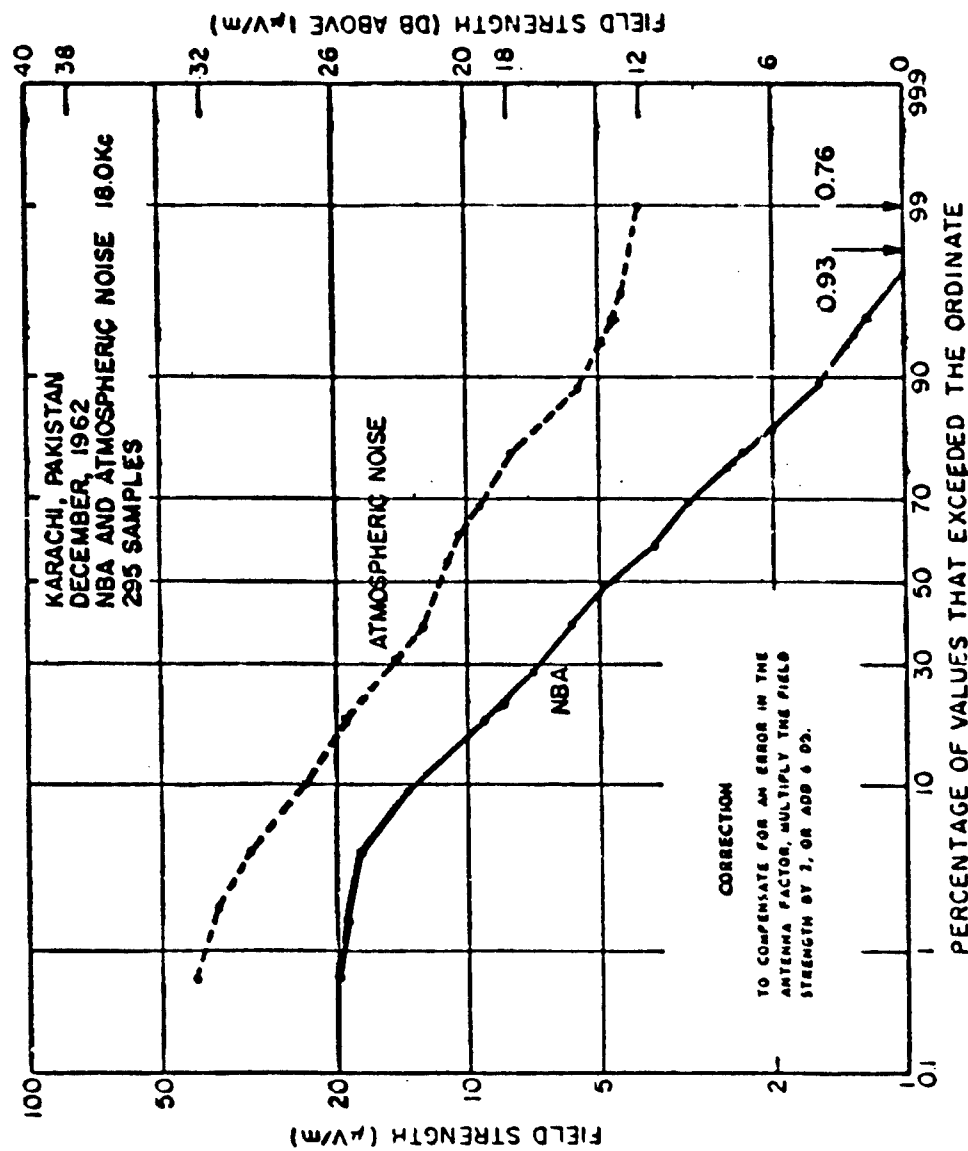


Figure 267

CONFIDENTIAL

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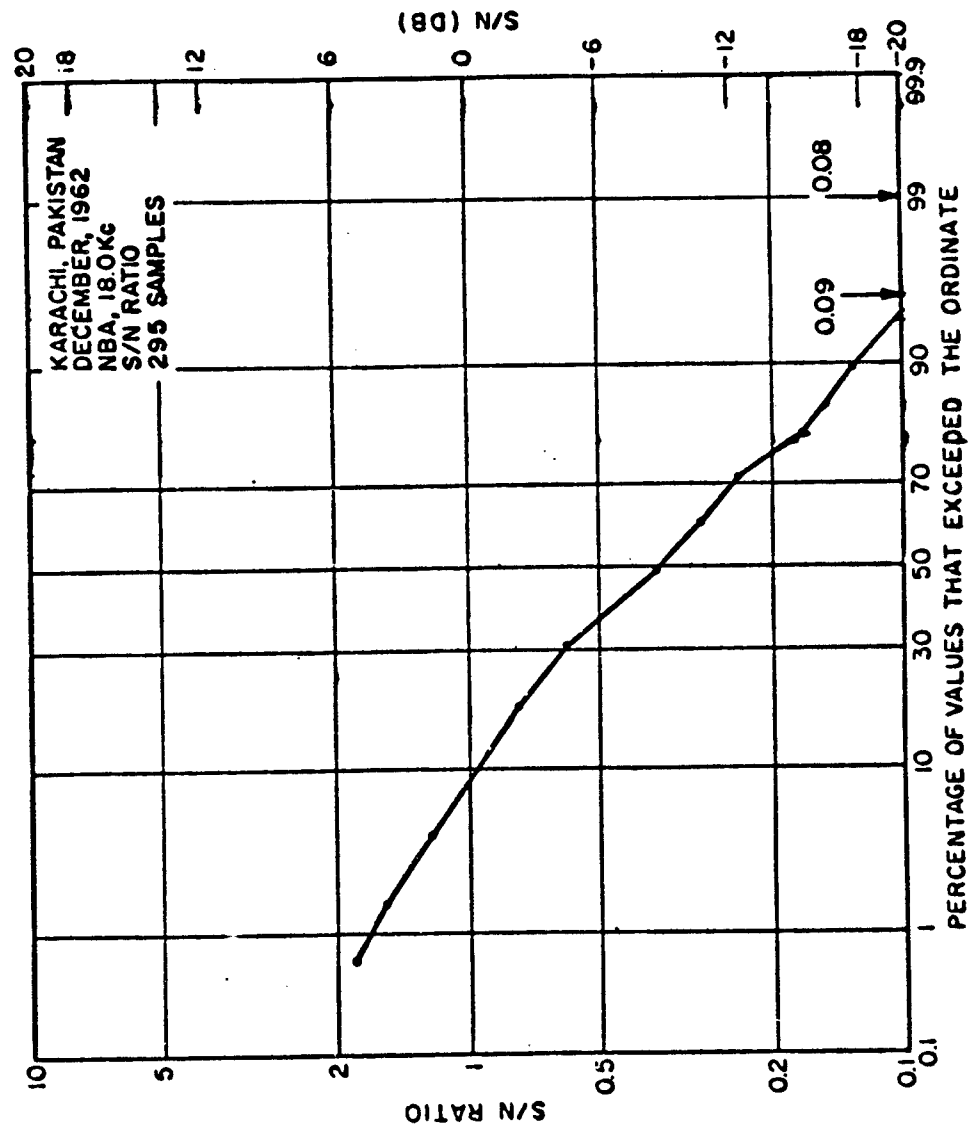


Figure 268

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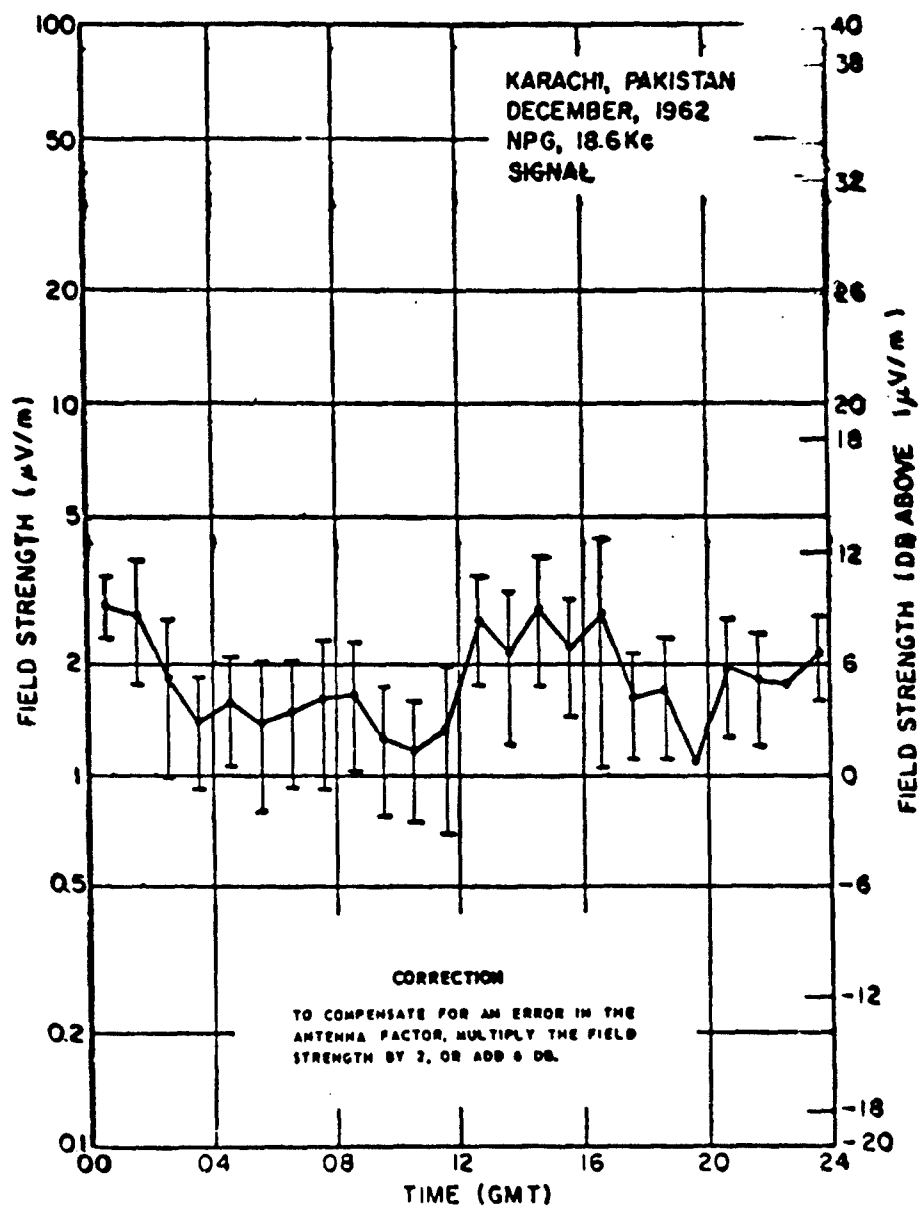


Figure 269

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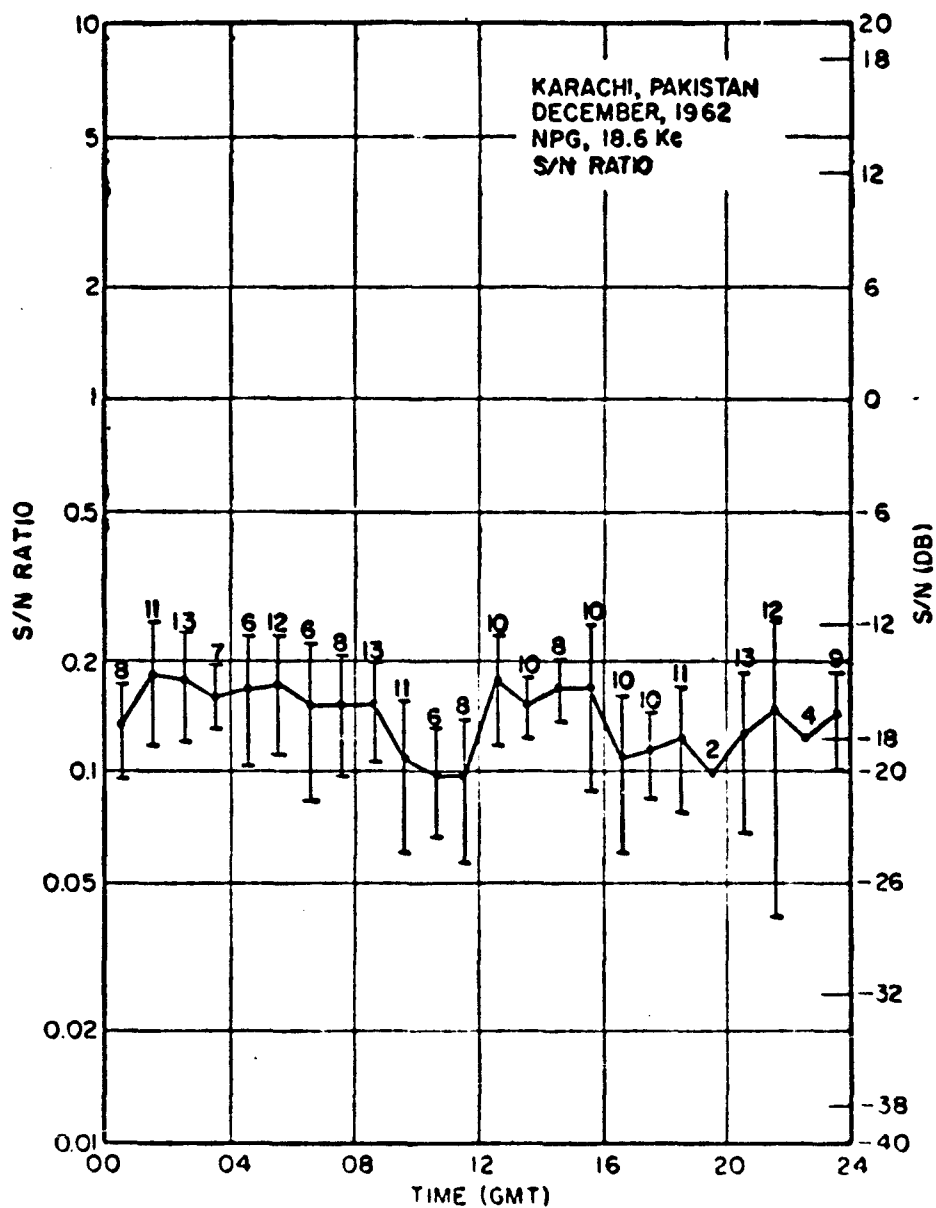


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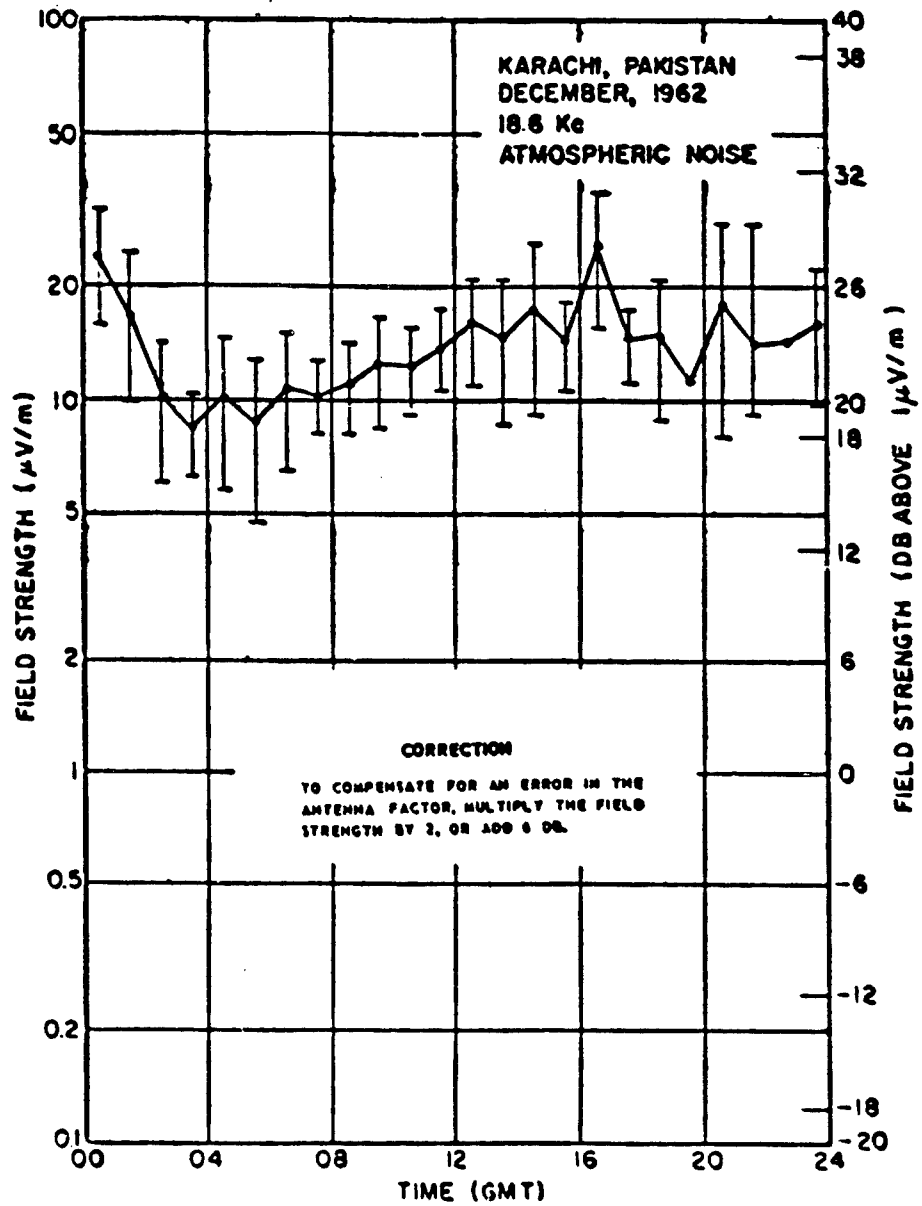


Figure 271

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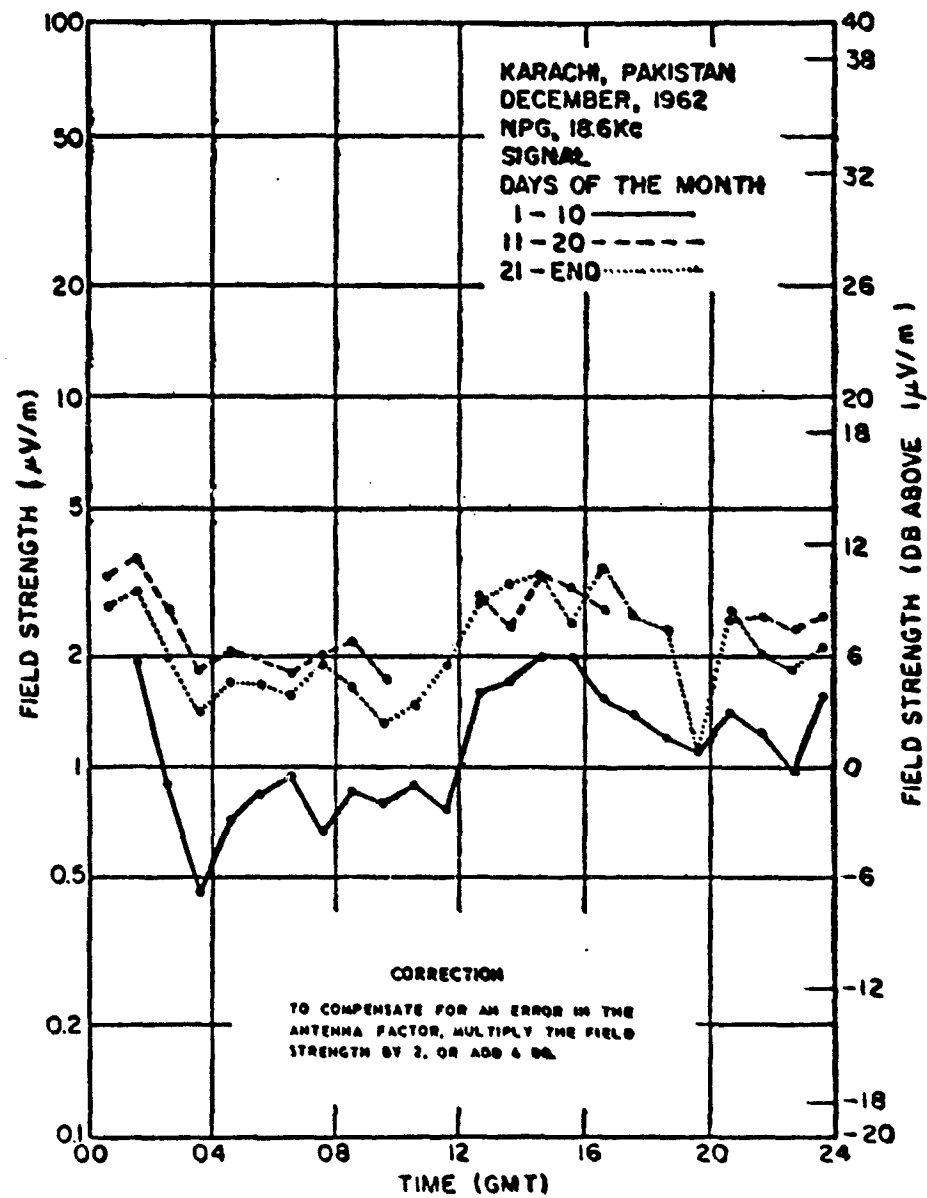


Figure 272

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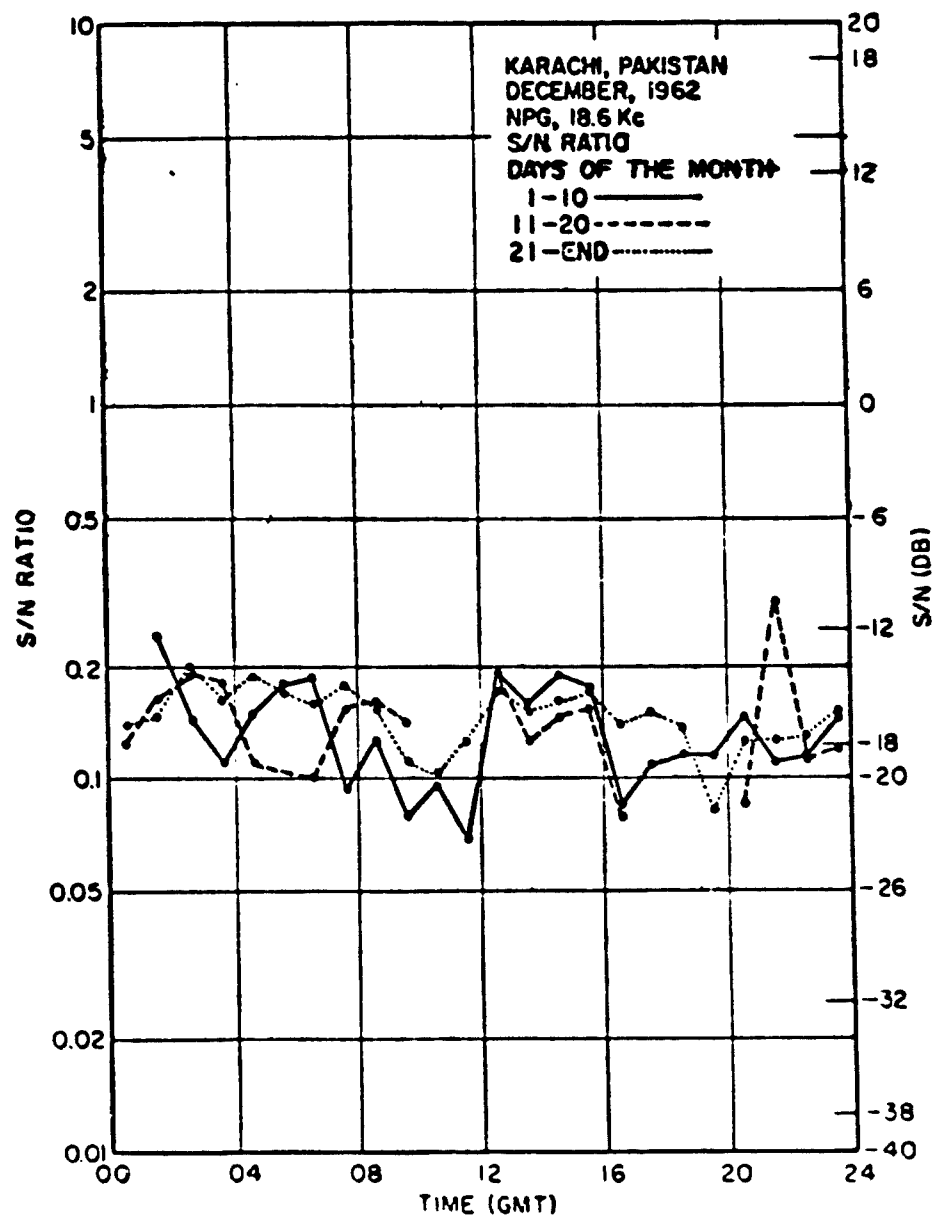


Figure 273

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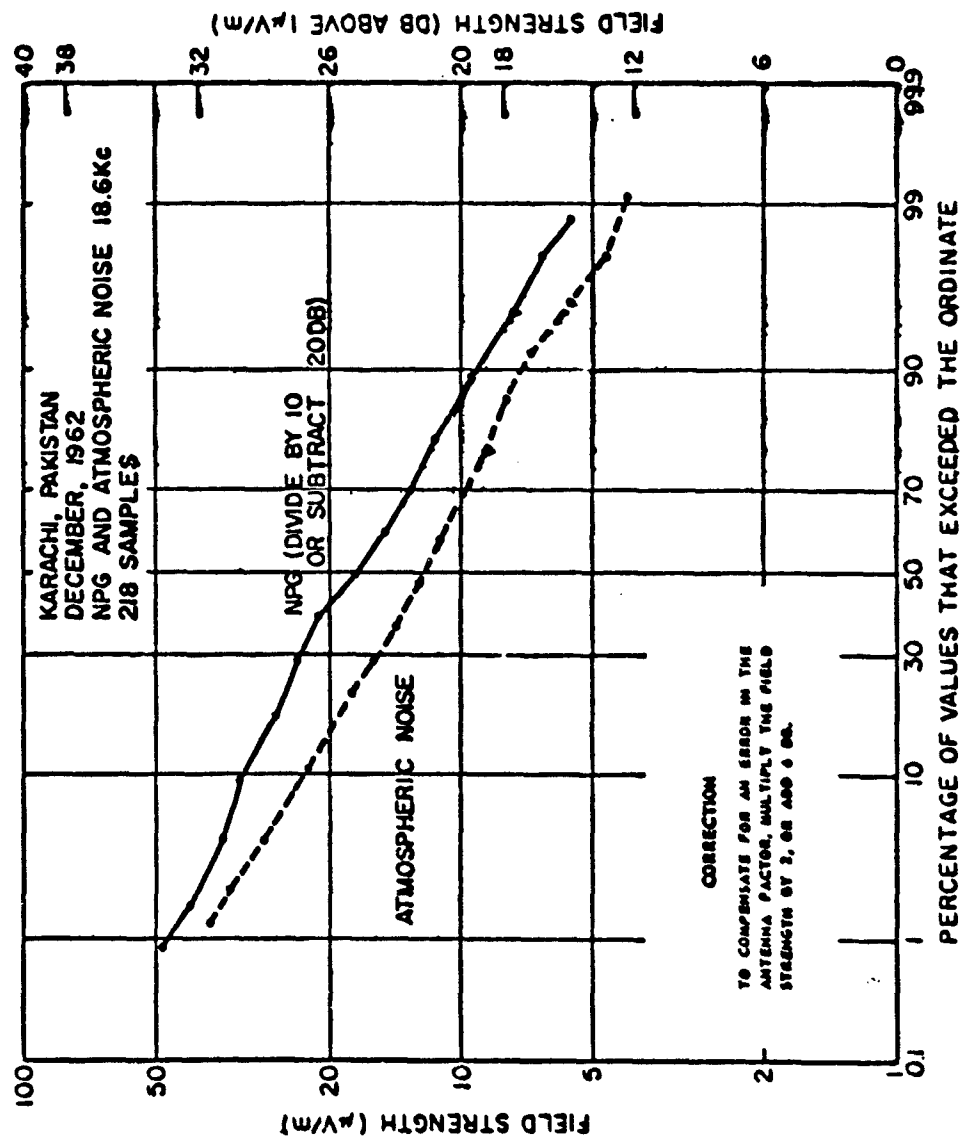


Figure 274

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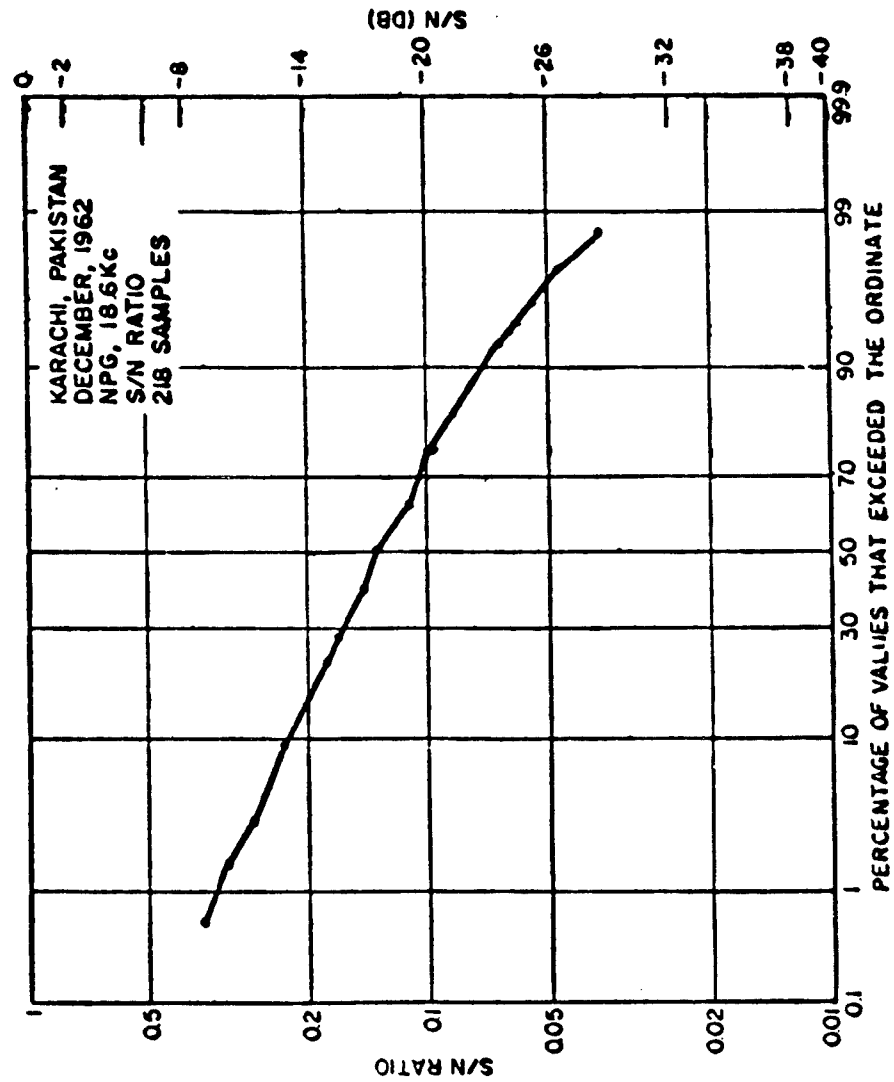


Figure 273

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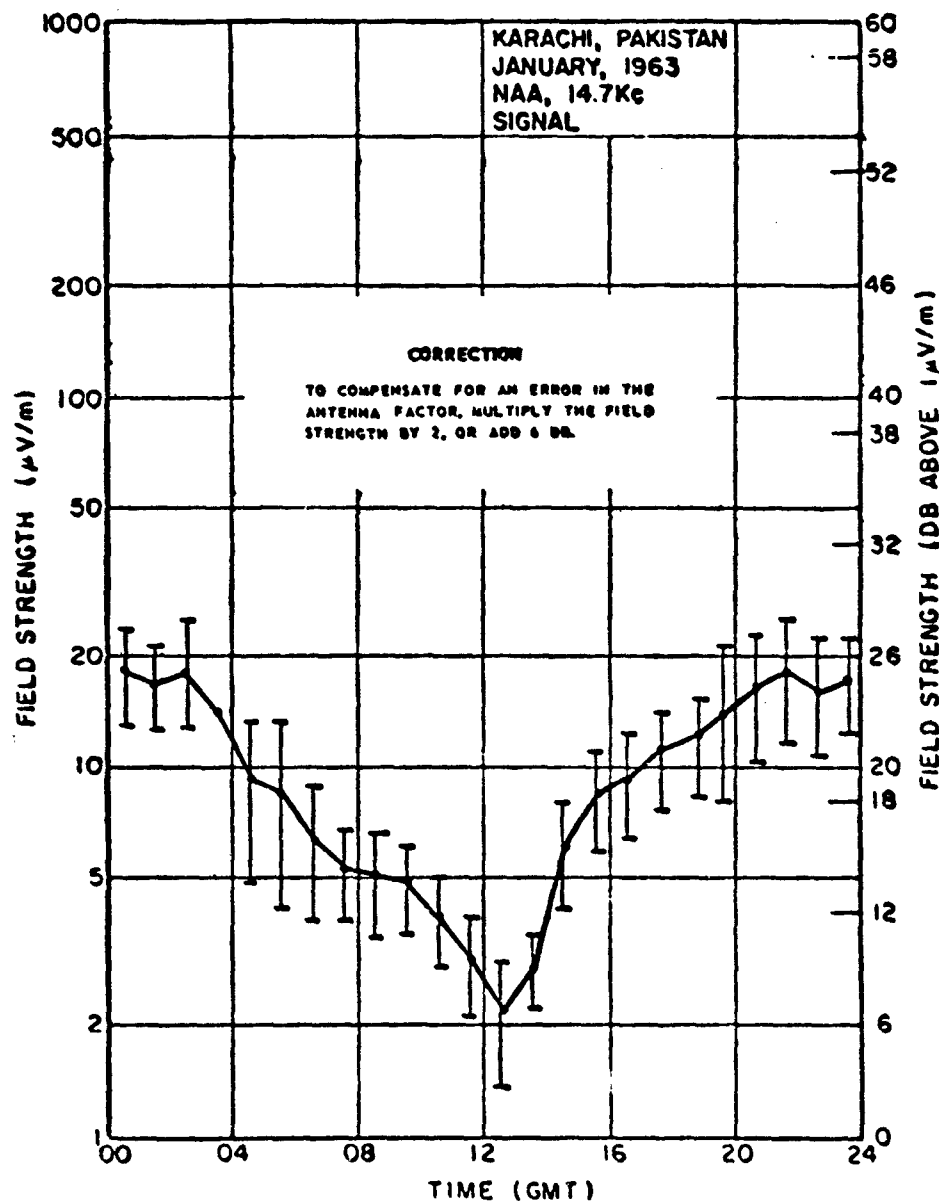


Figure 276

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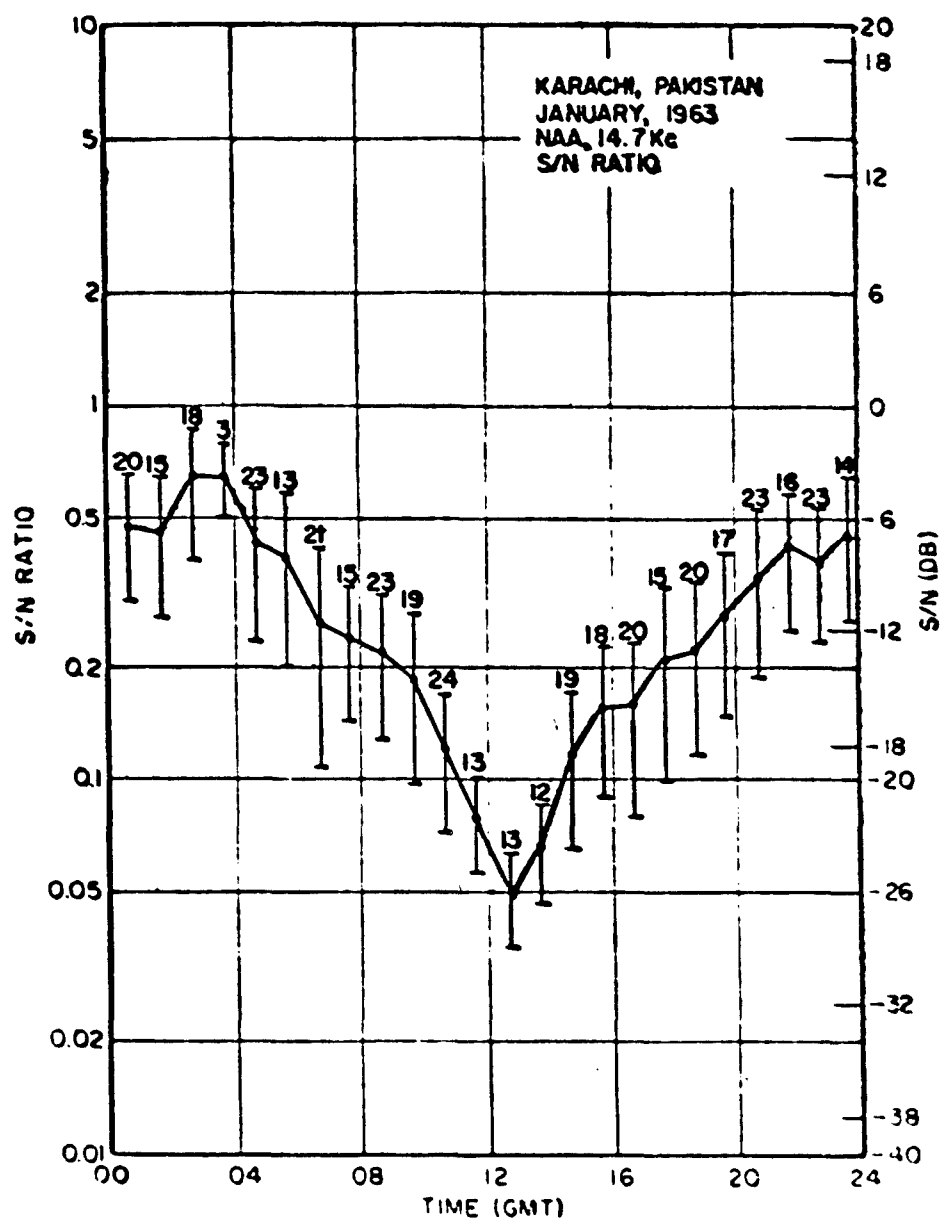


Figure 277

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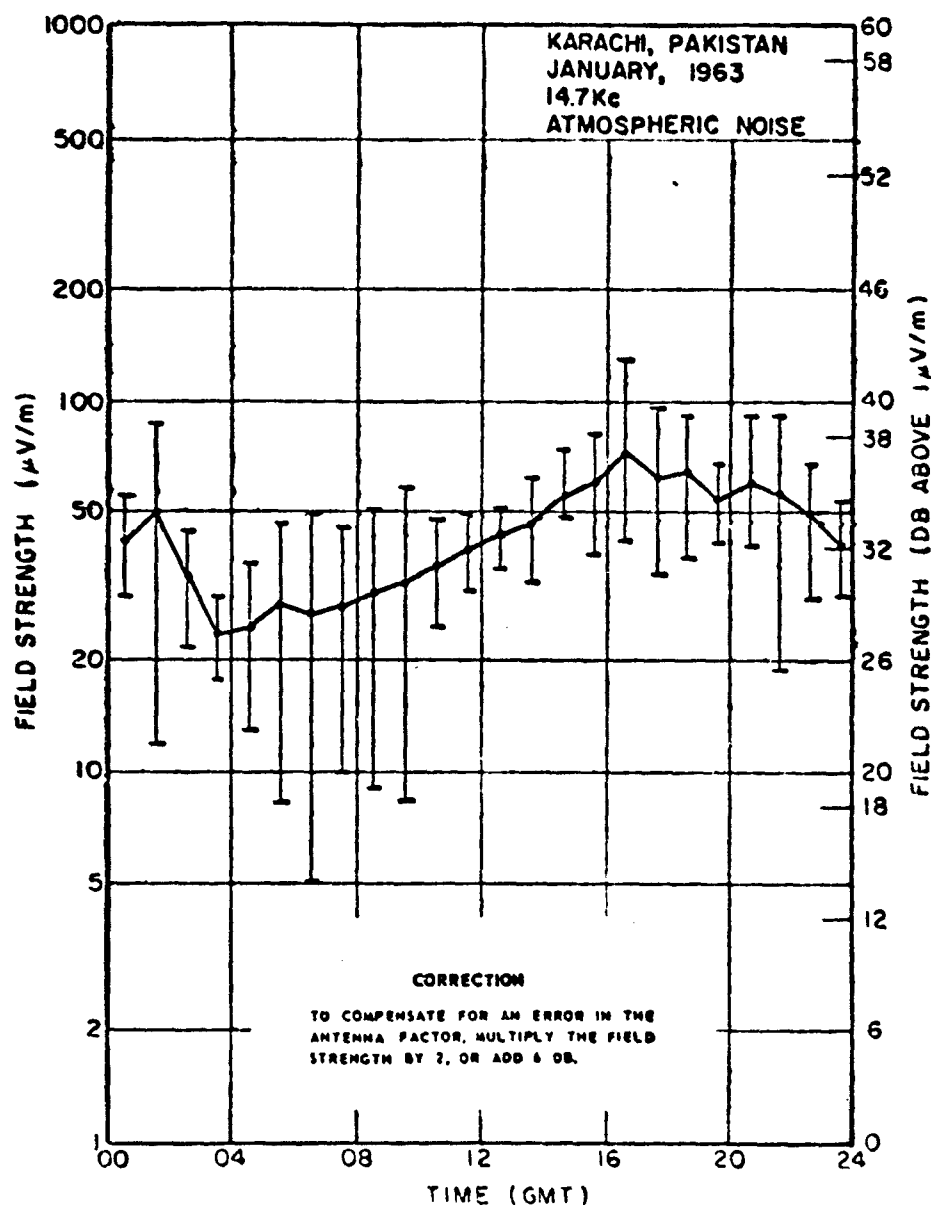


Figure 278

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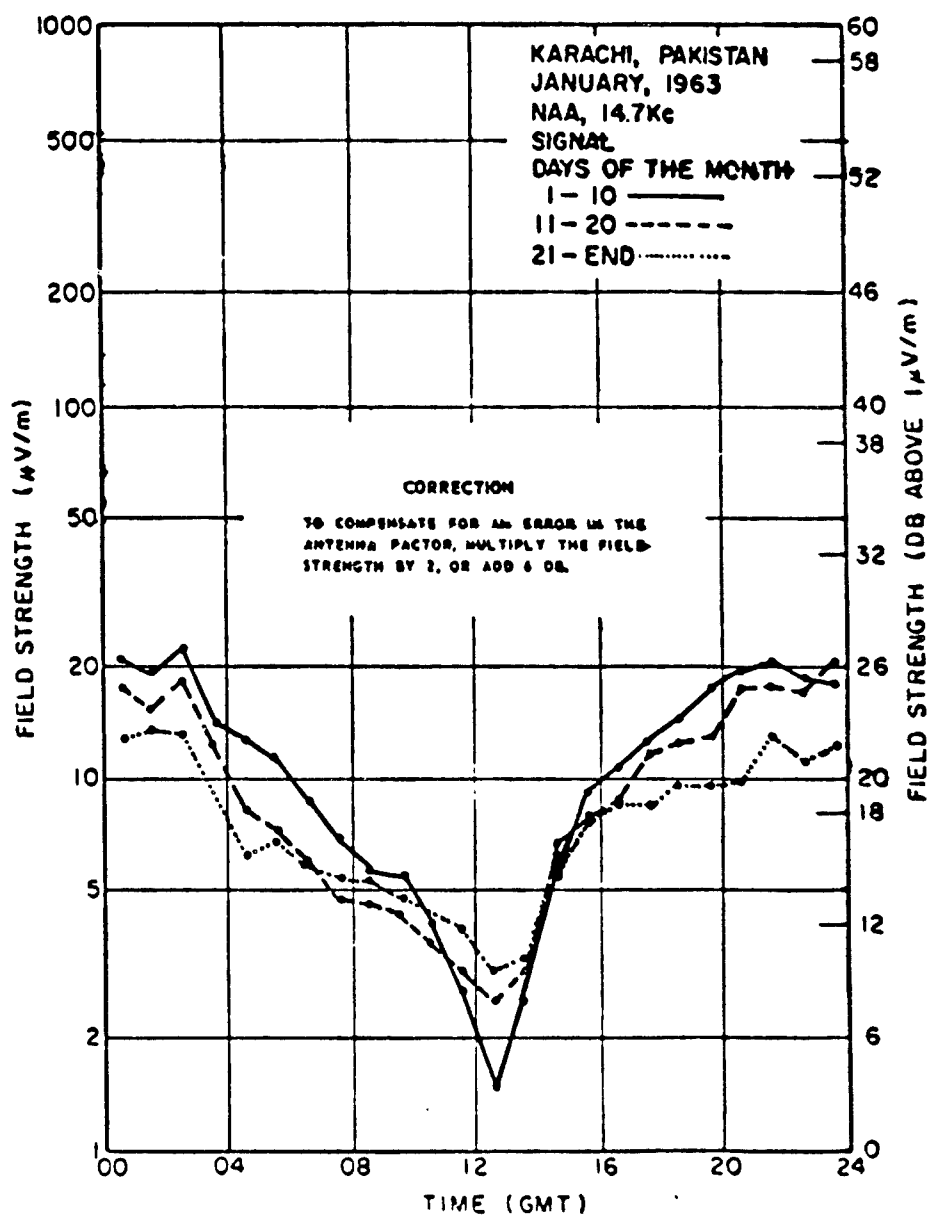


Figure 276

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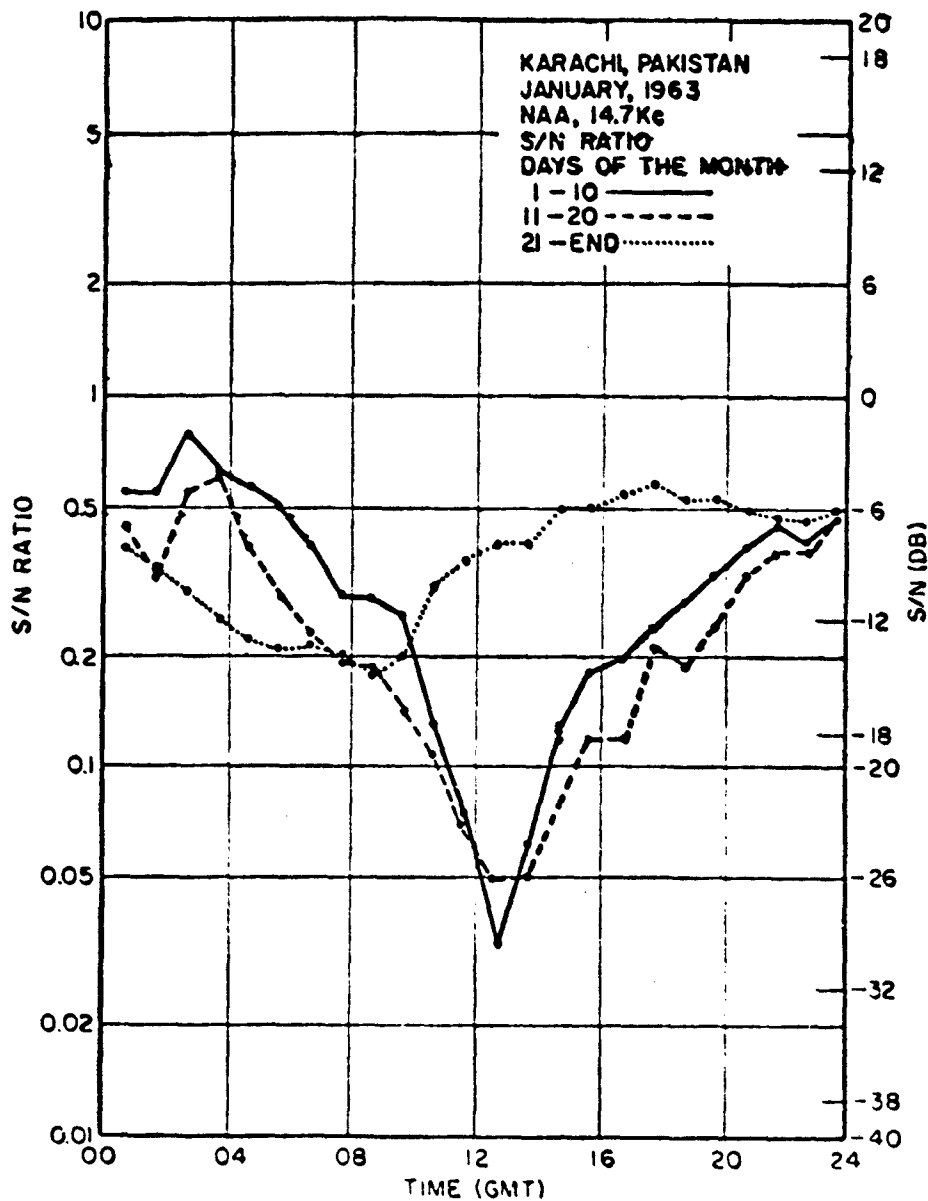


Figure 280

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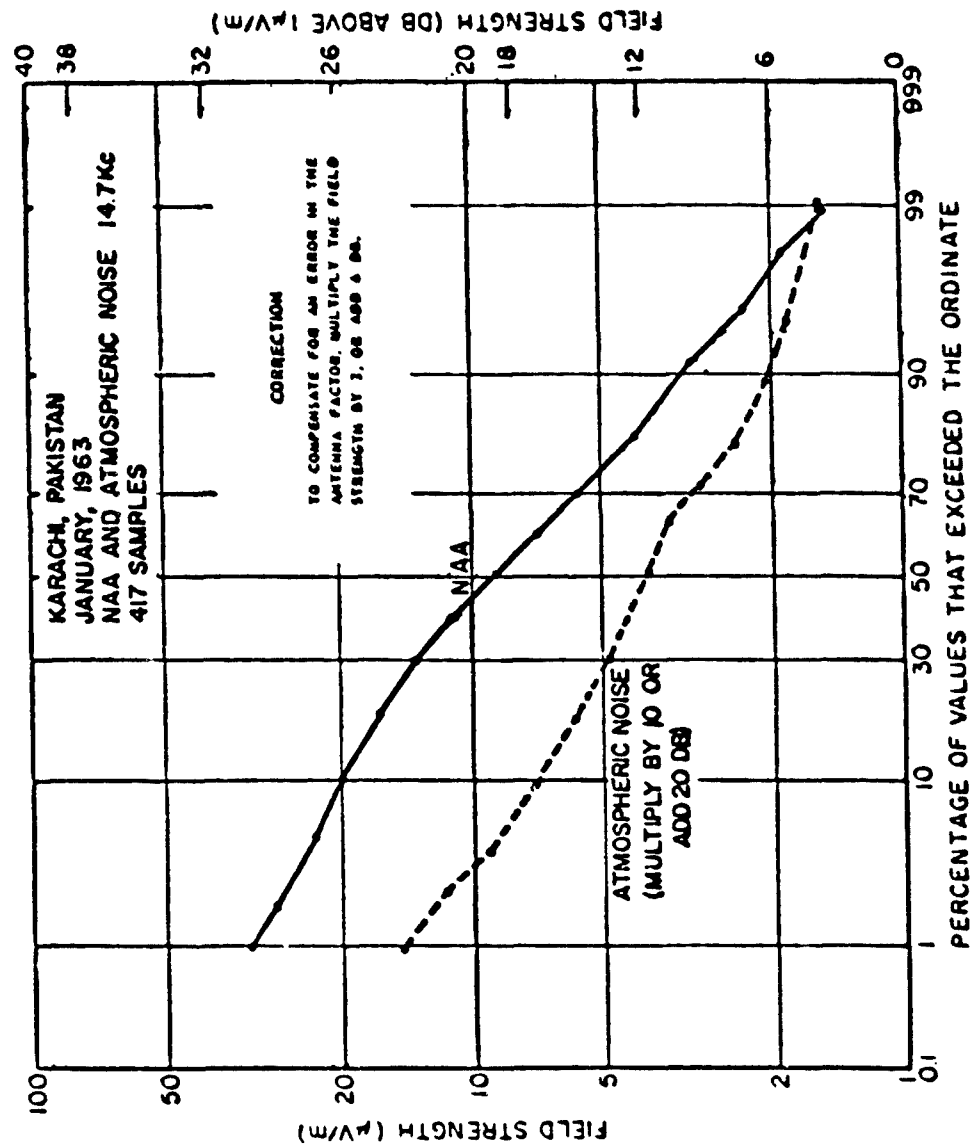


Figure 281

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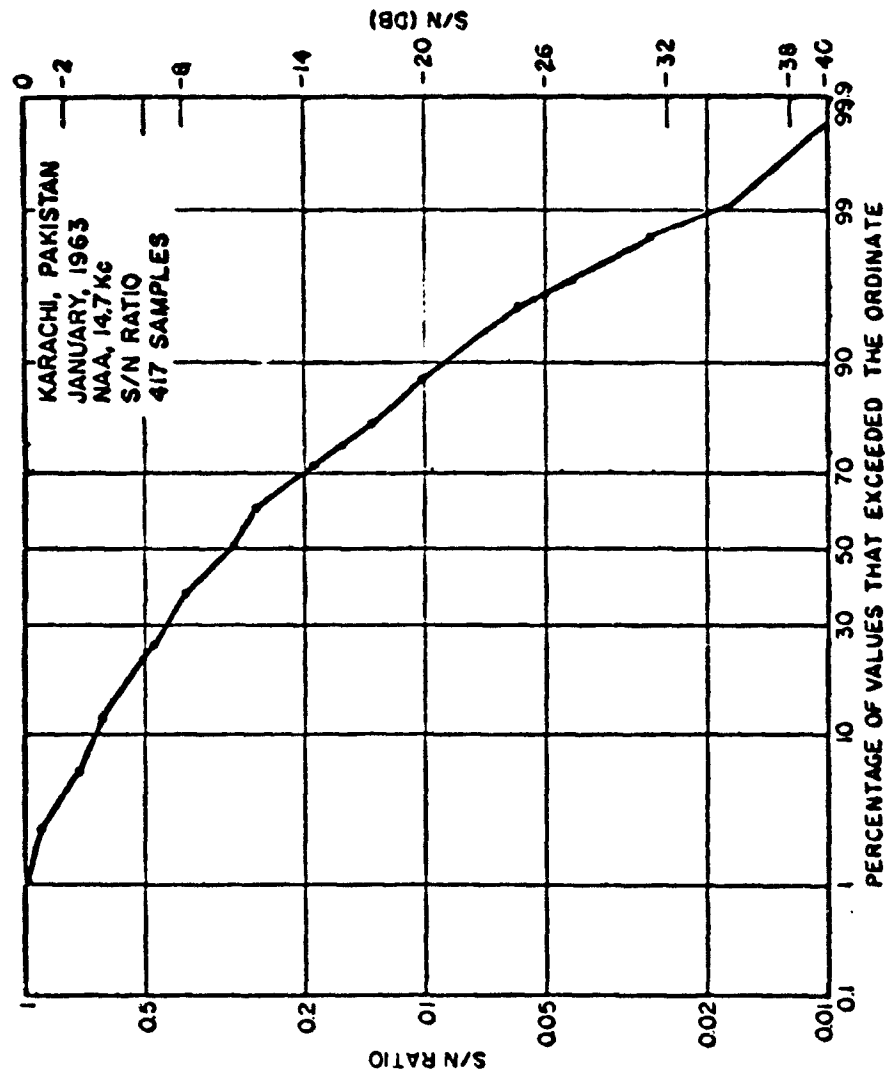


Figure 282

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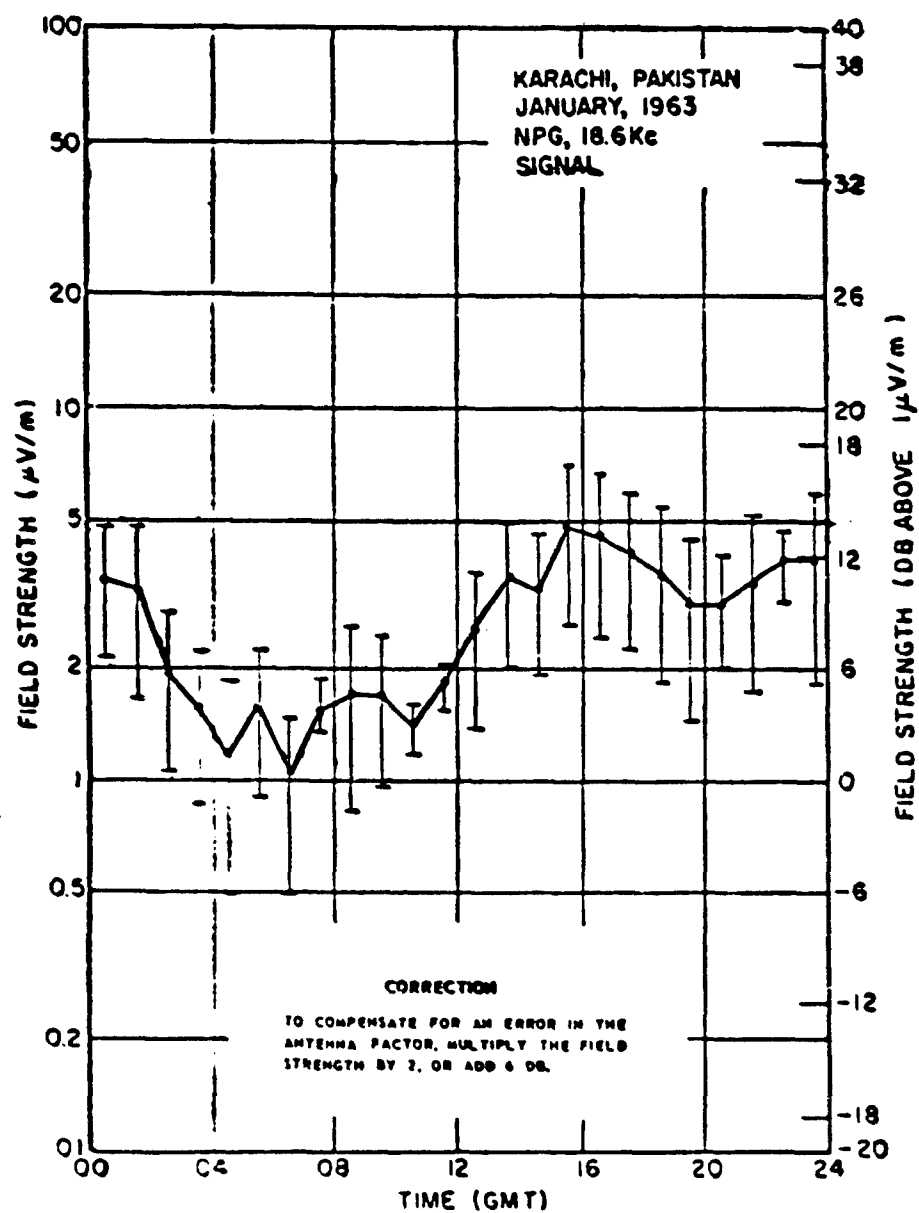


Figure 283

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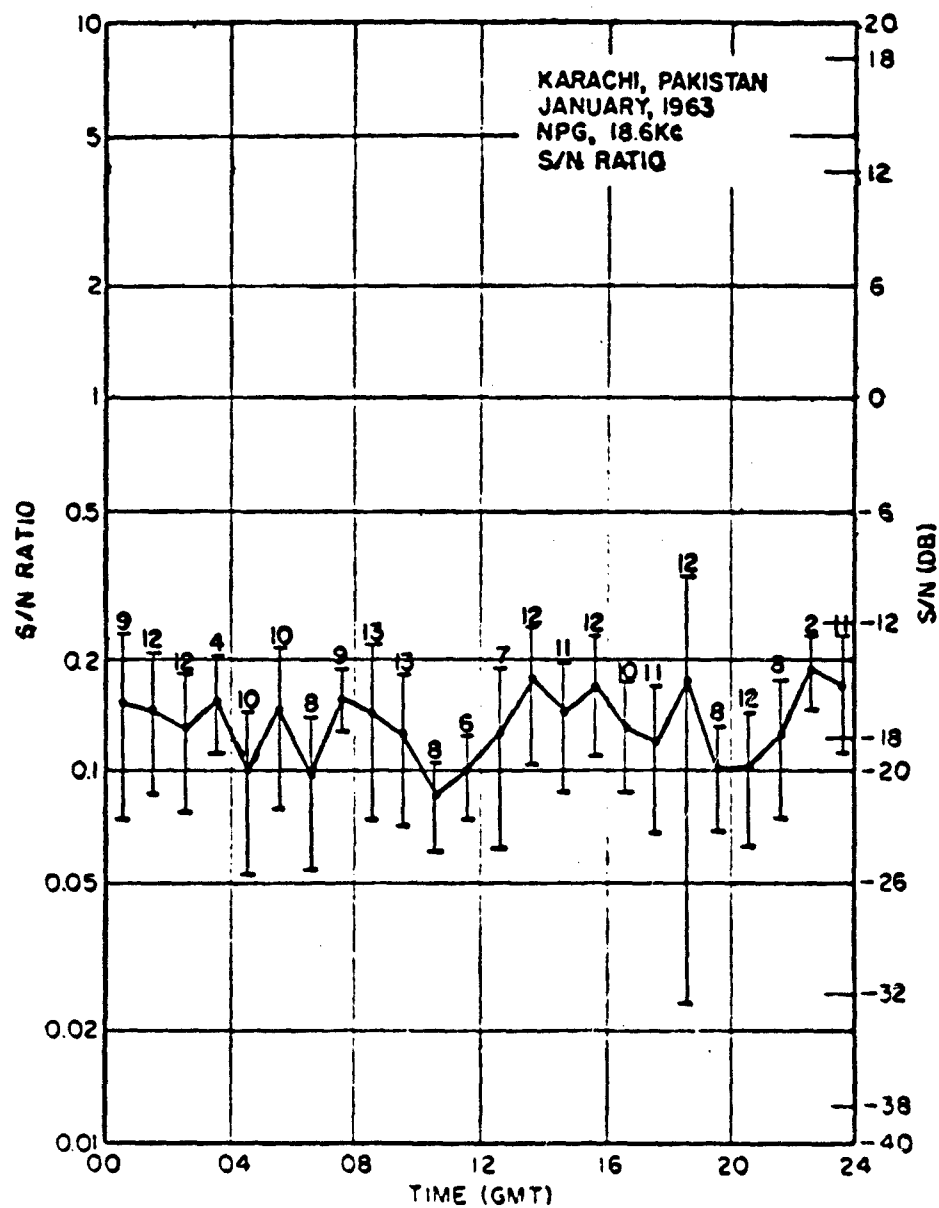


Figure 284

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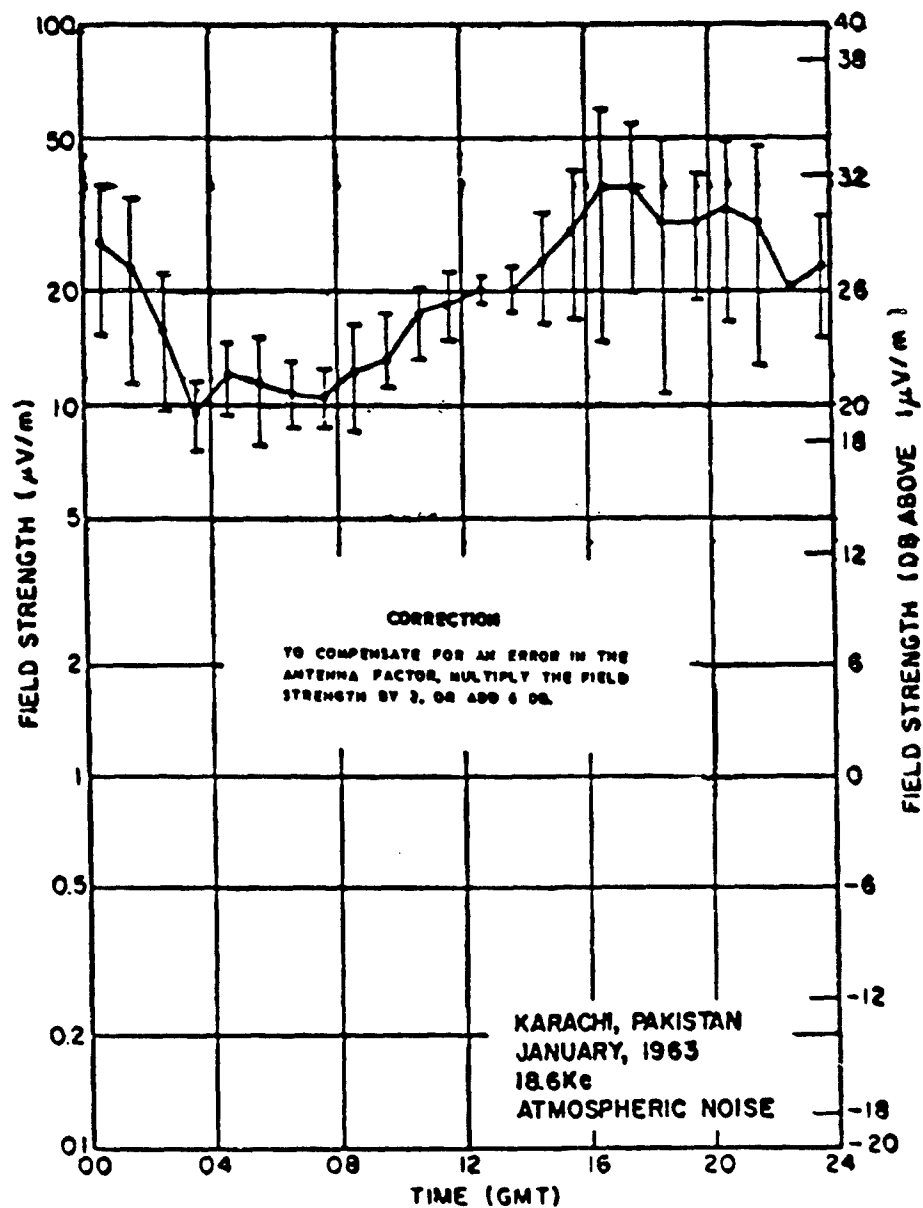


Figure 285

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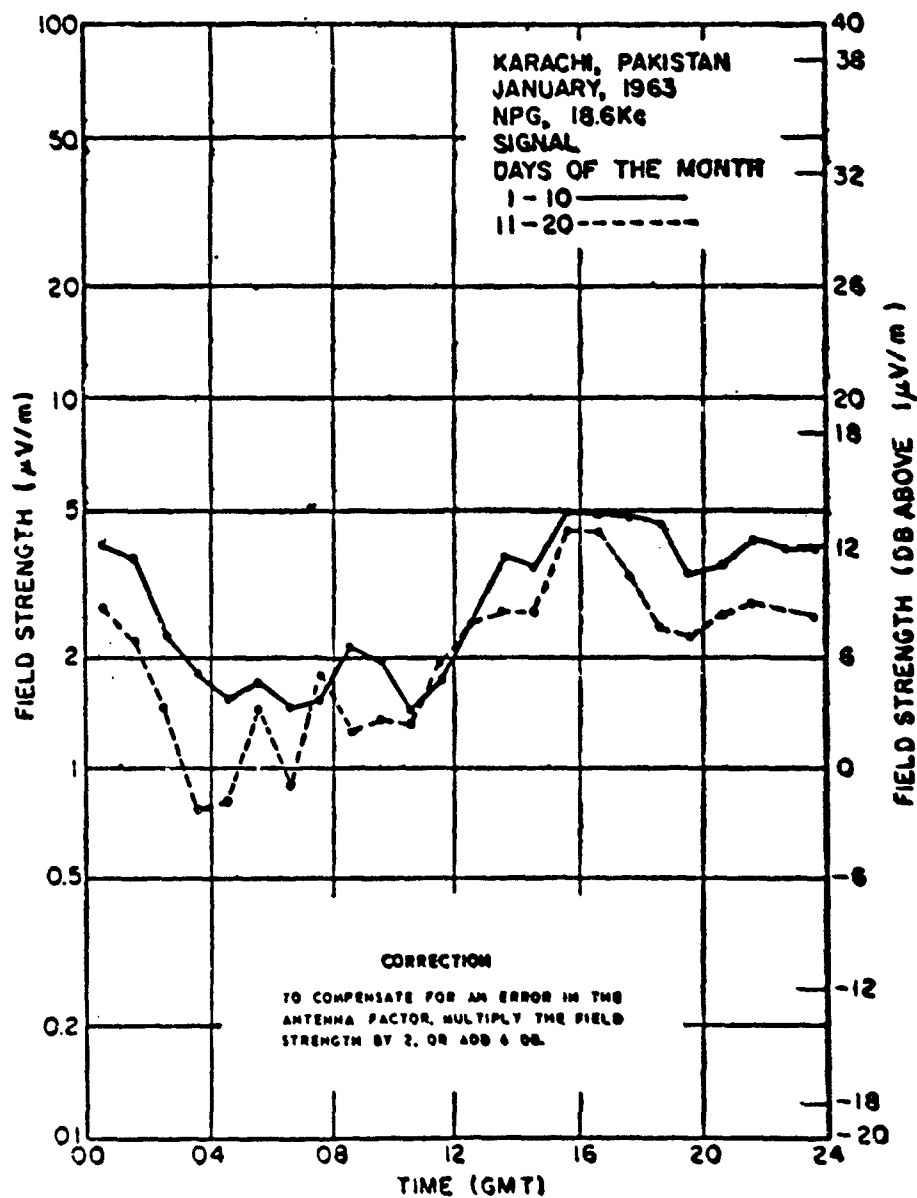


Figure 286

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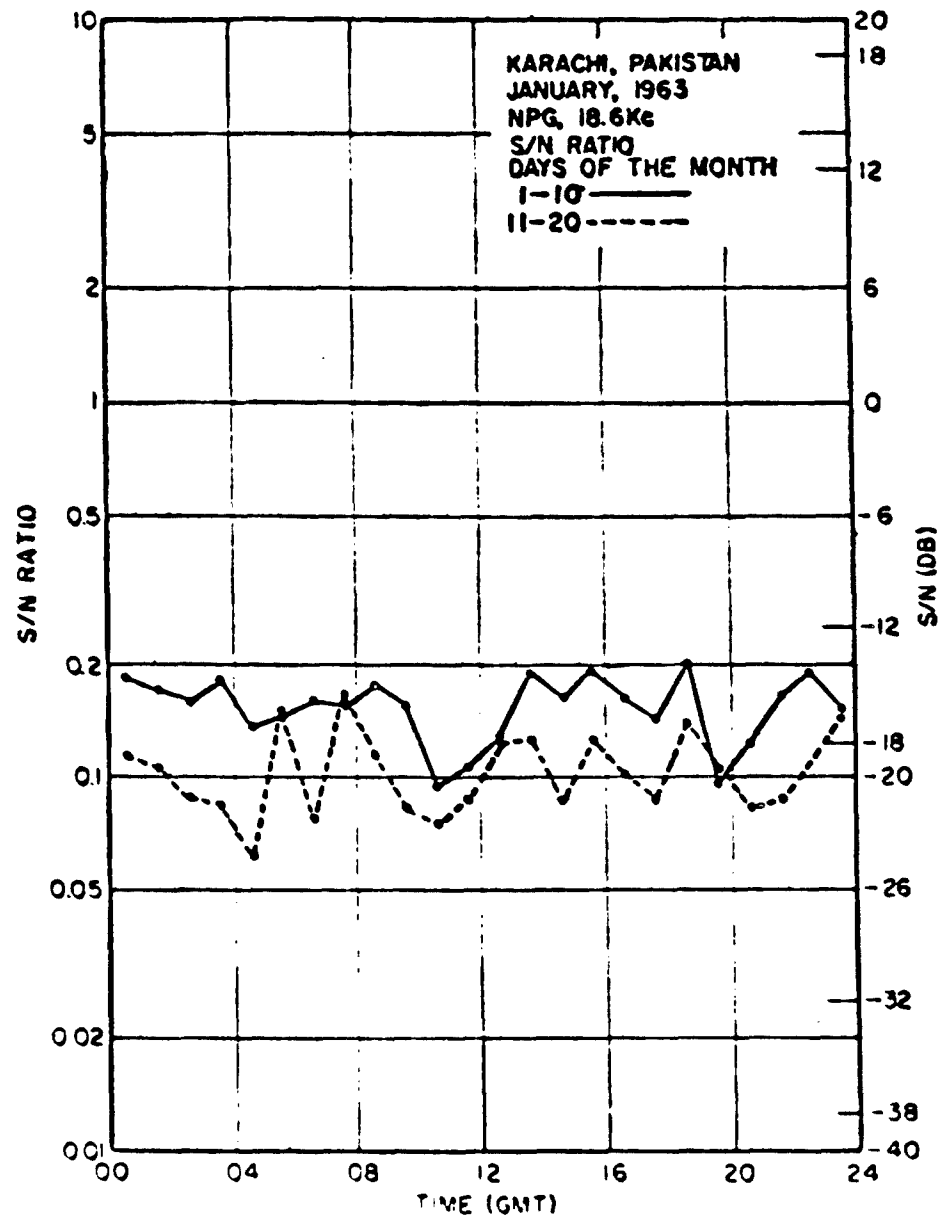


Figure 287

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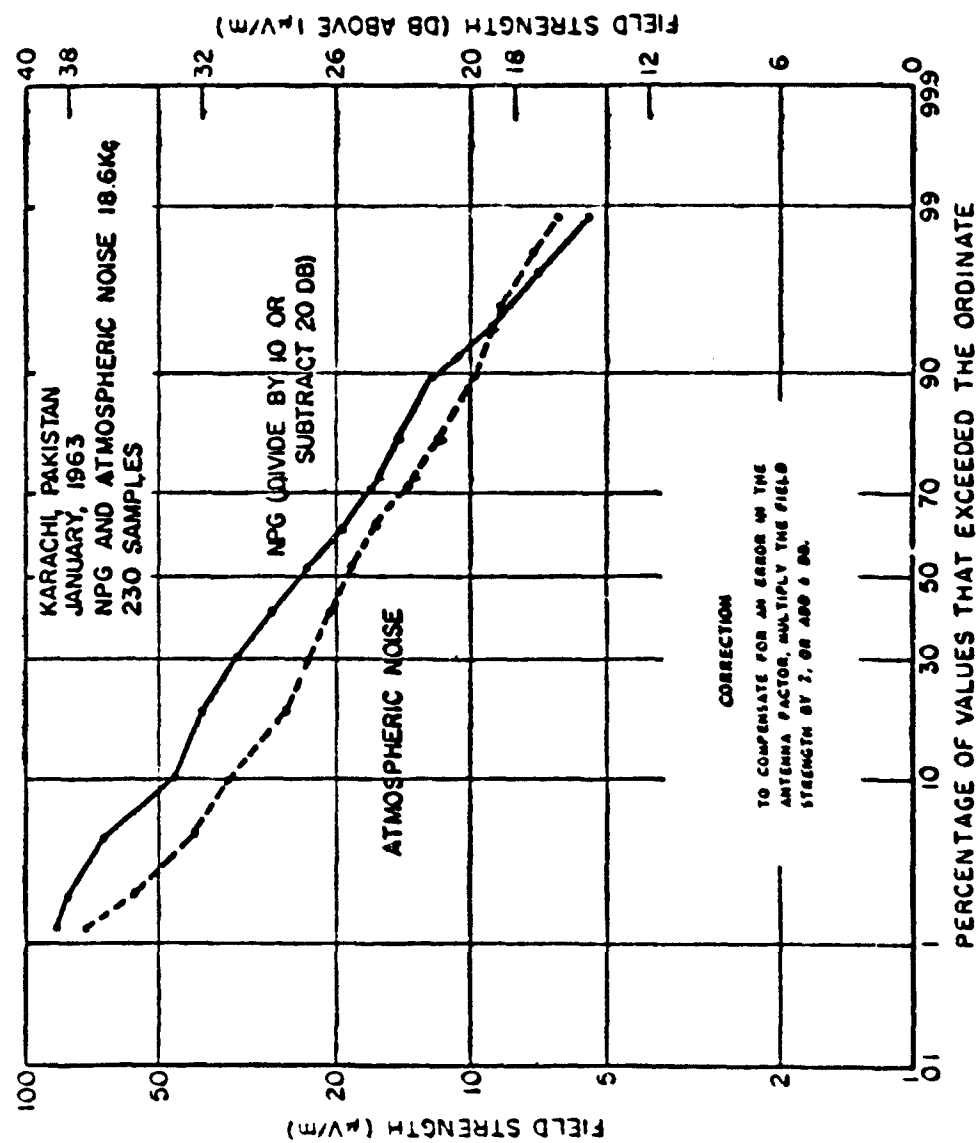


Figure 288

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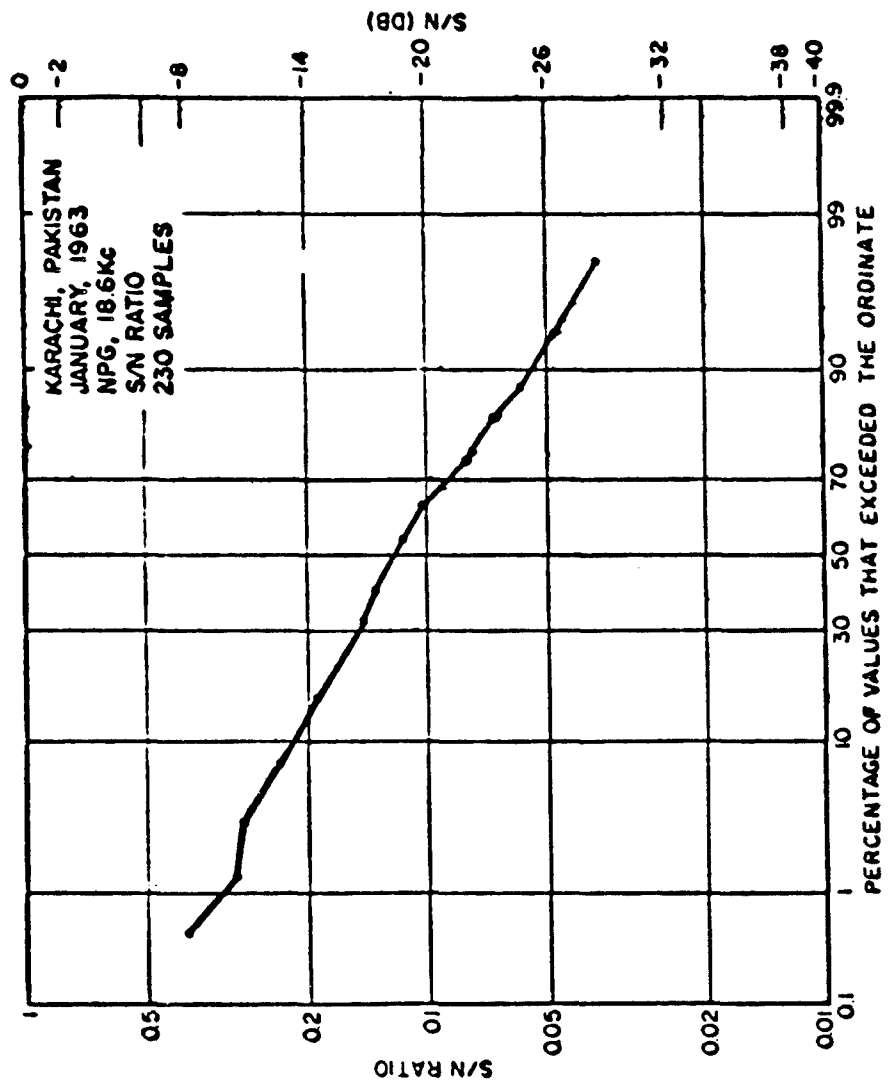


Figure 289

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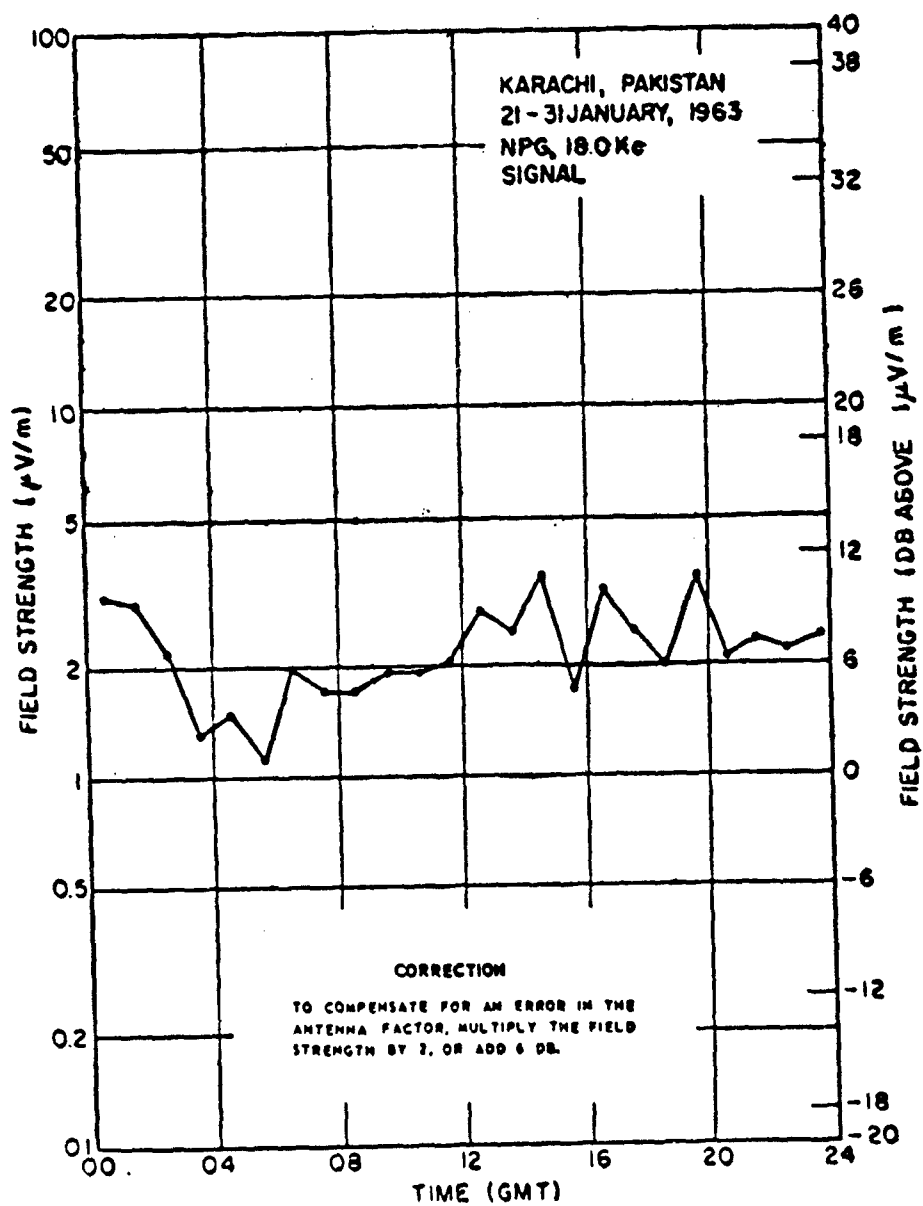


Figure 290

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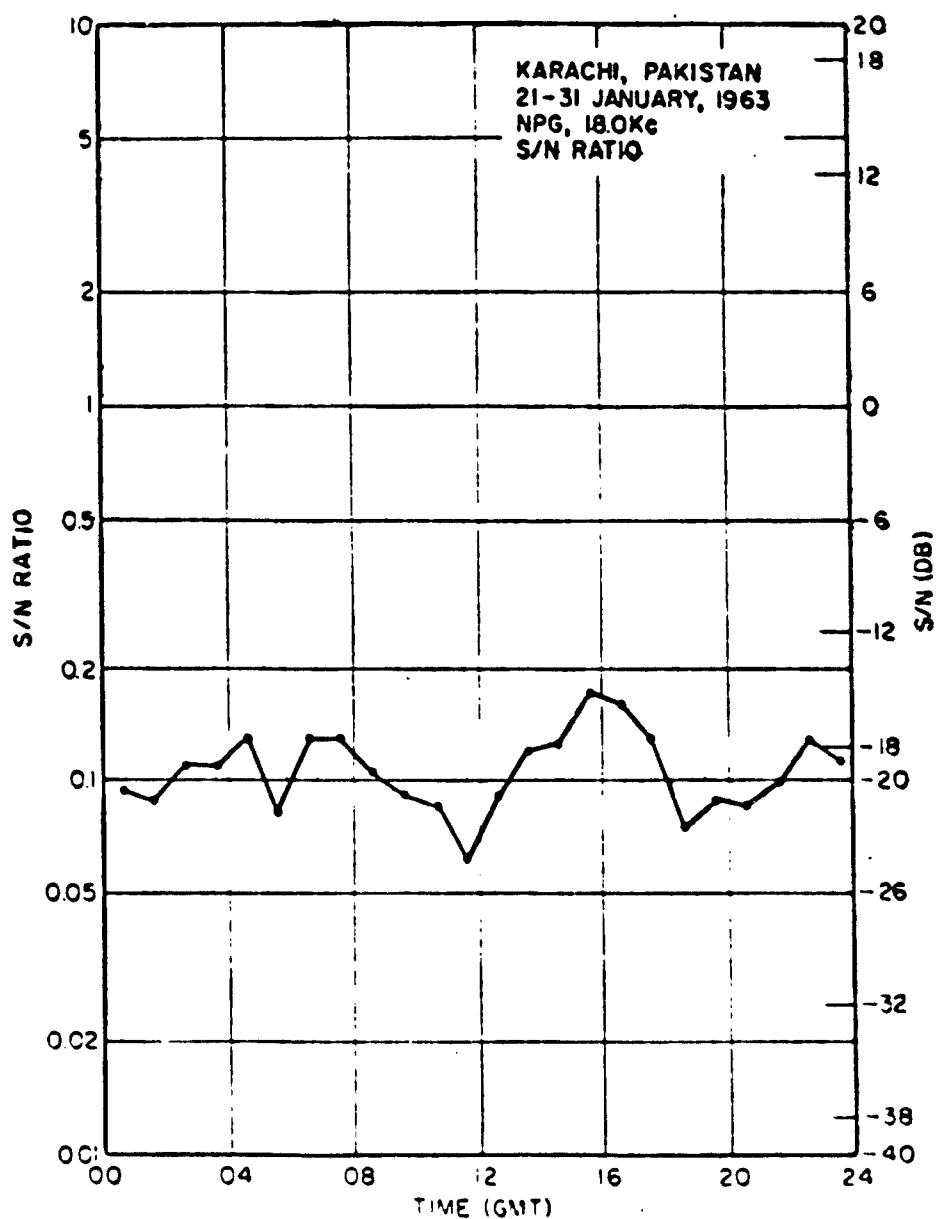


Figure 291

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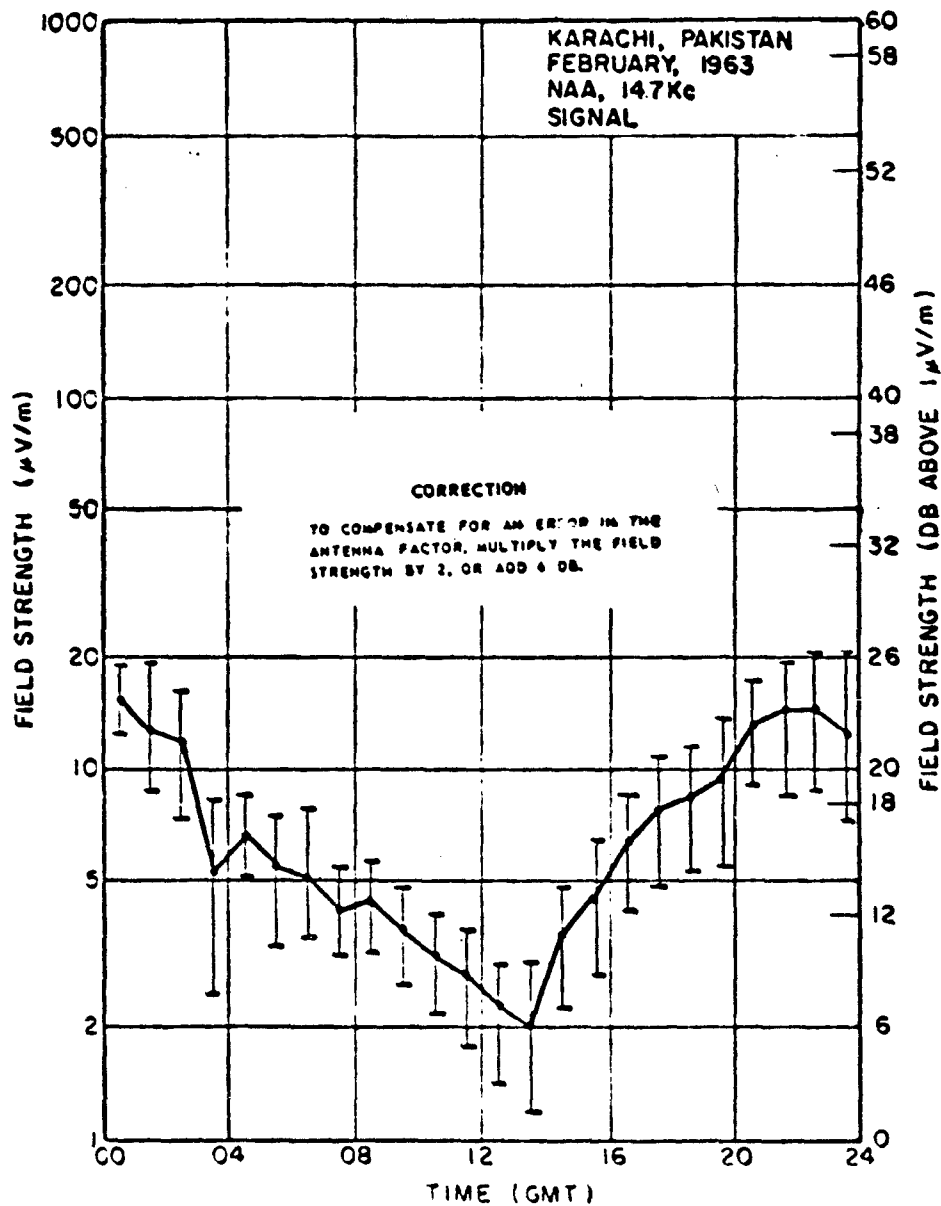


Figure 292

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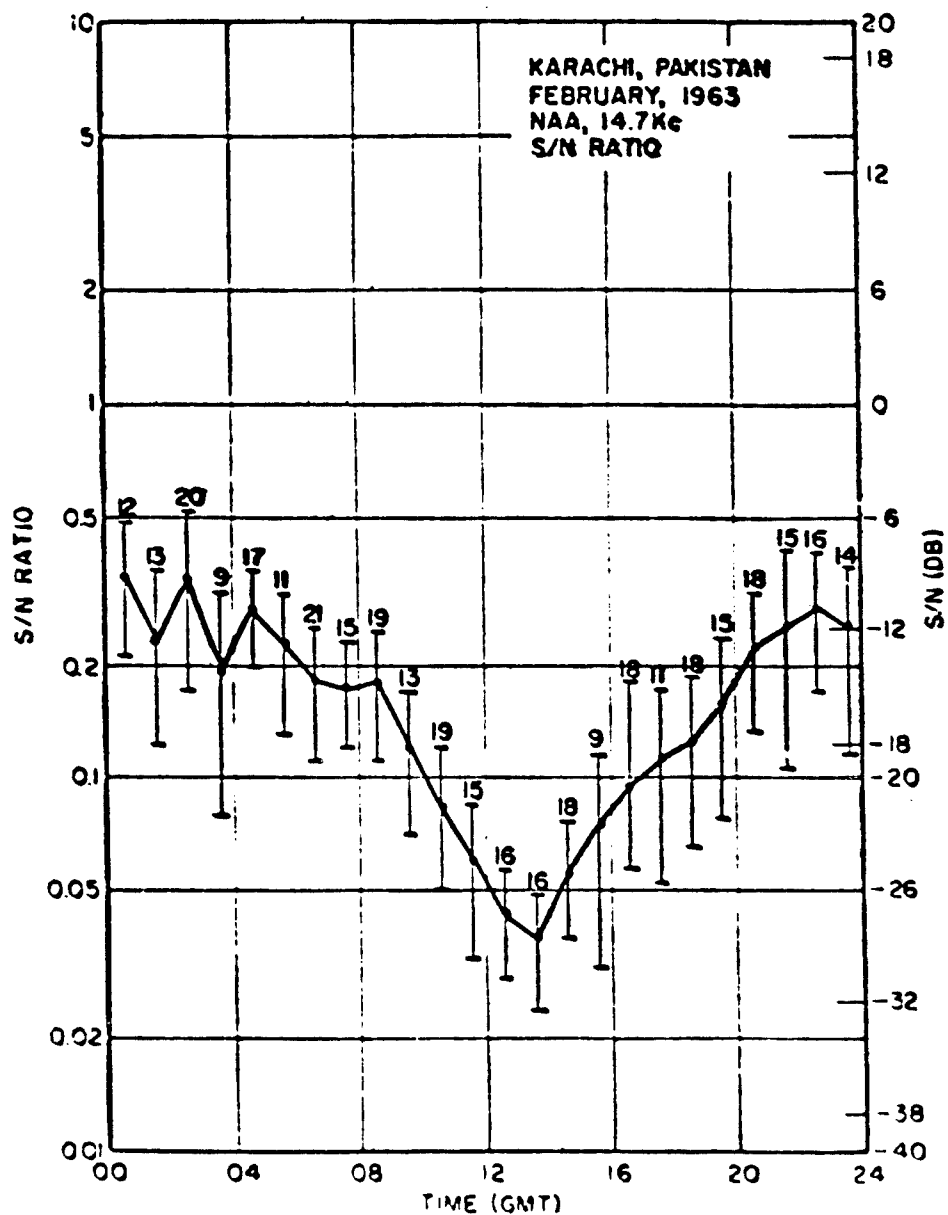


Figure 293

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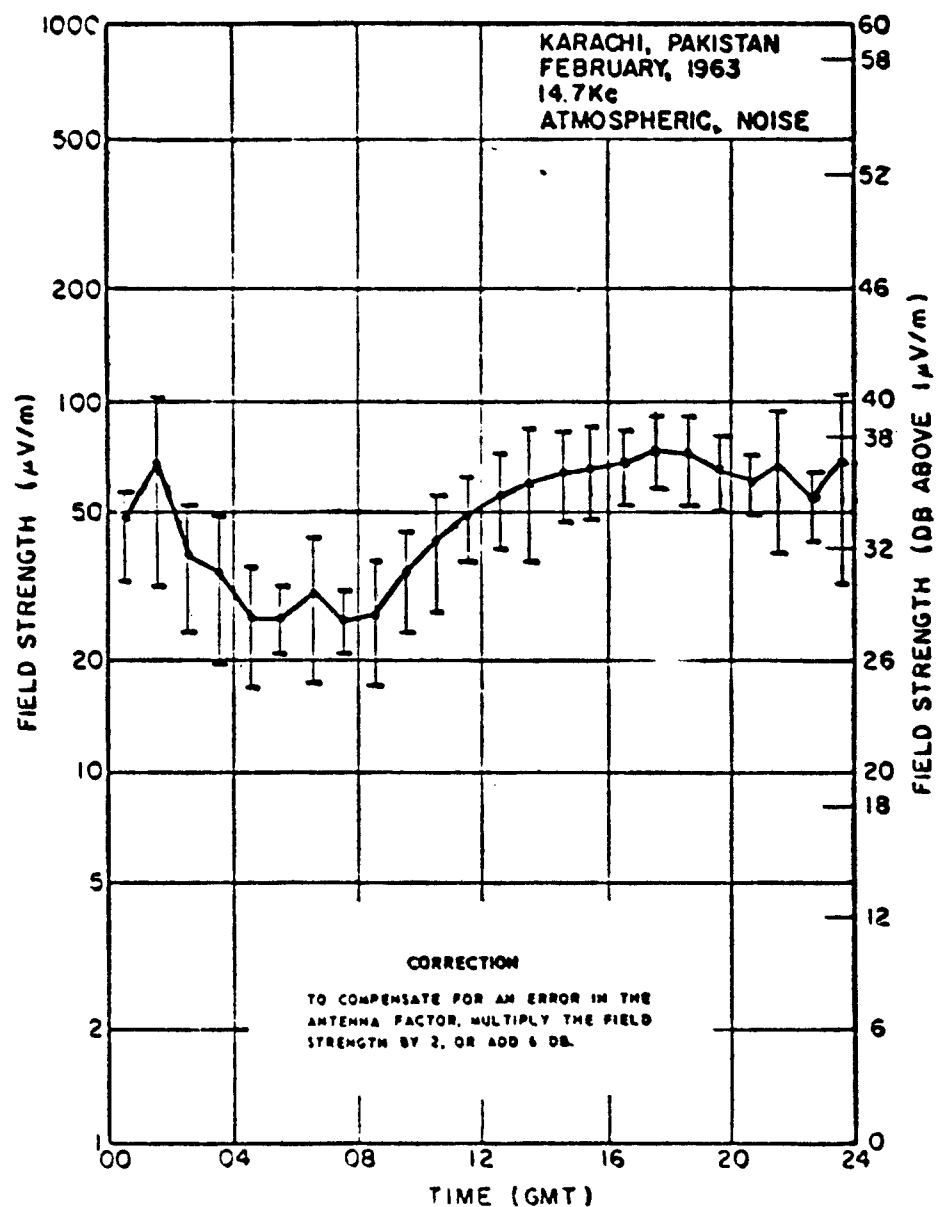


Figure 294

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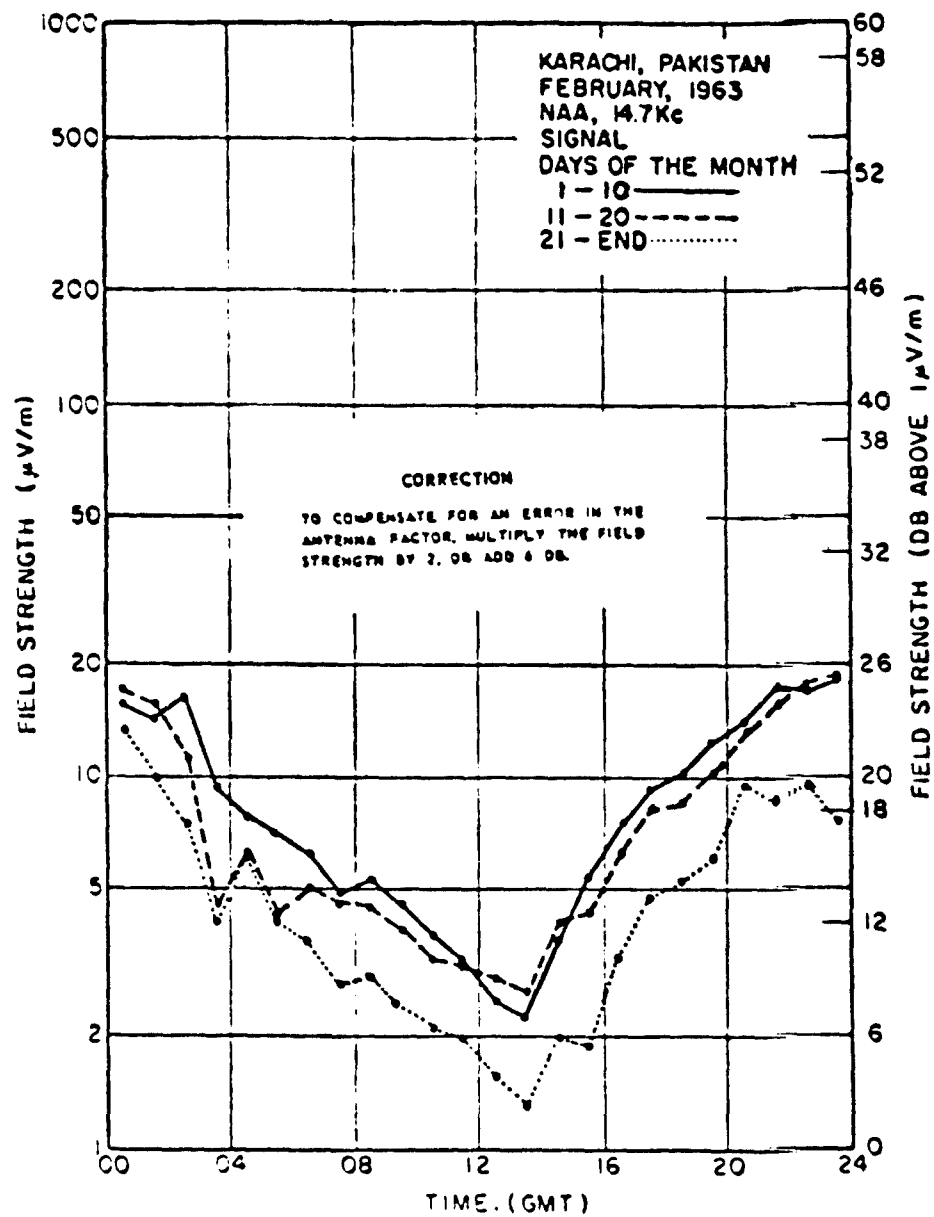


Figure 295

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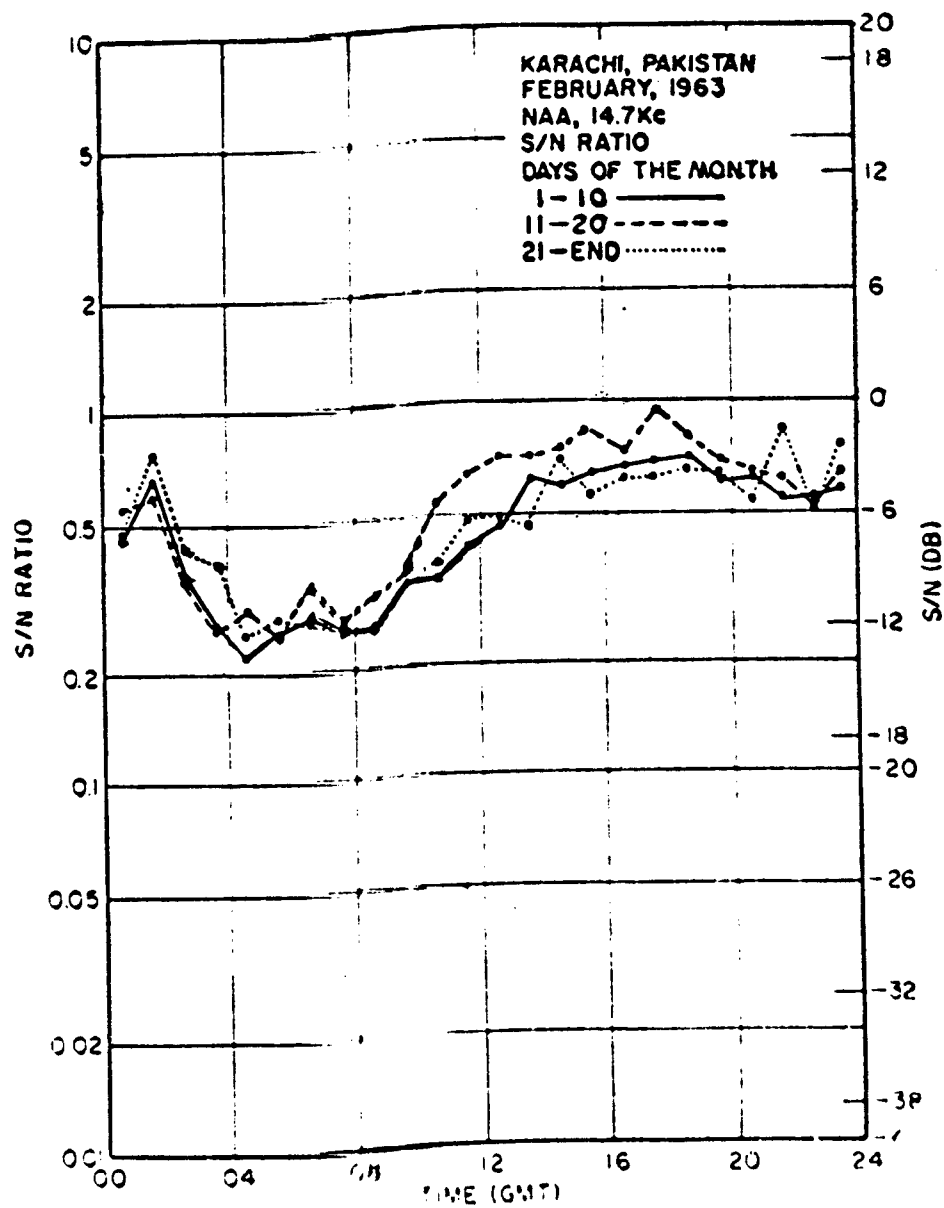


Figure 296

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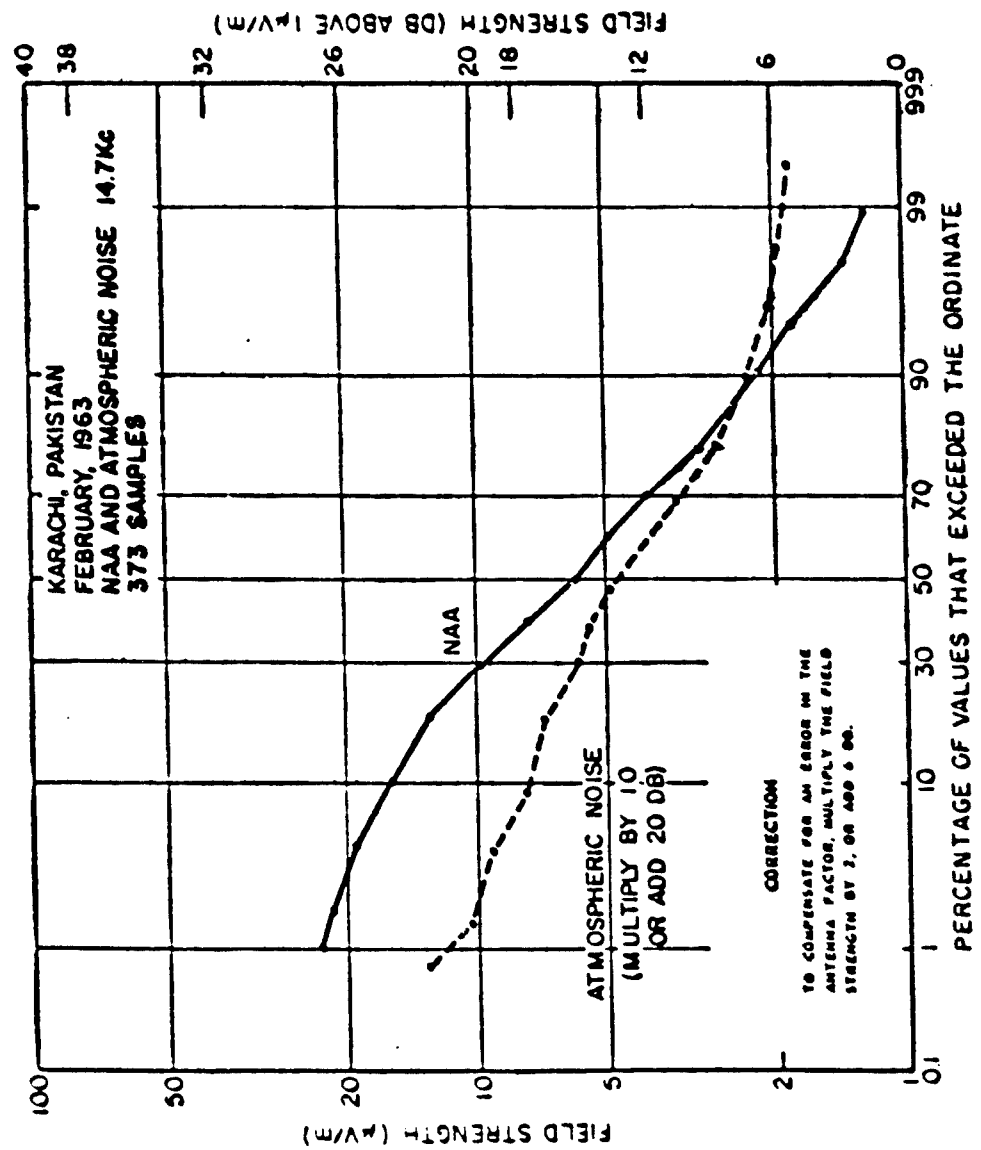


Figure 297

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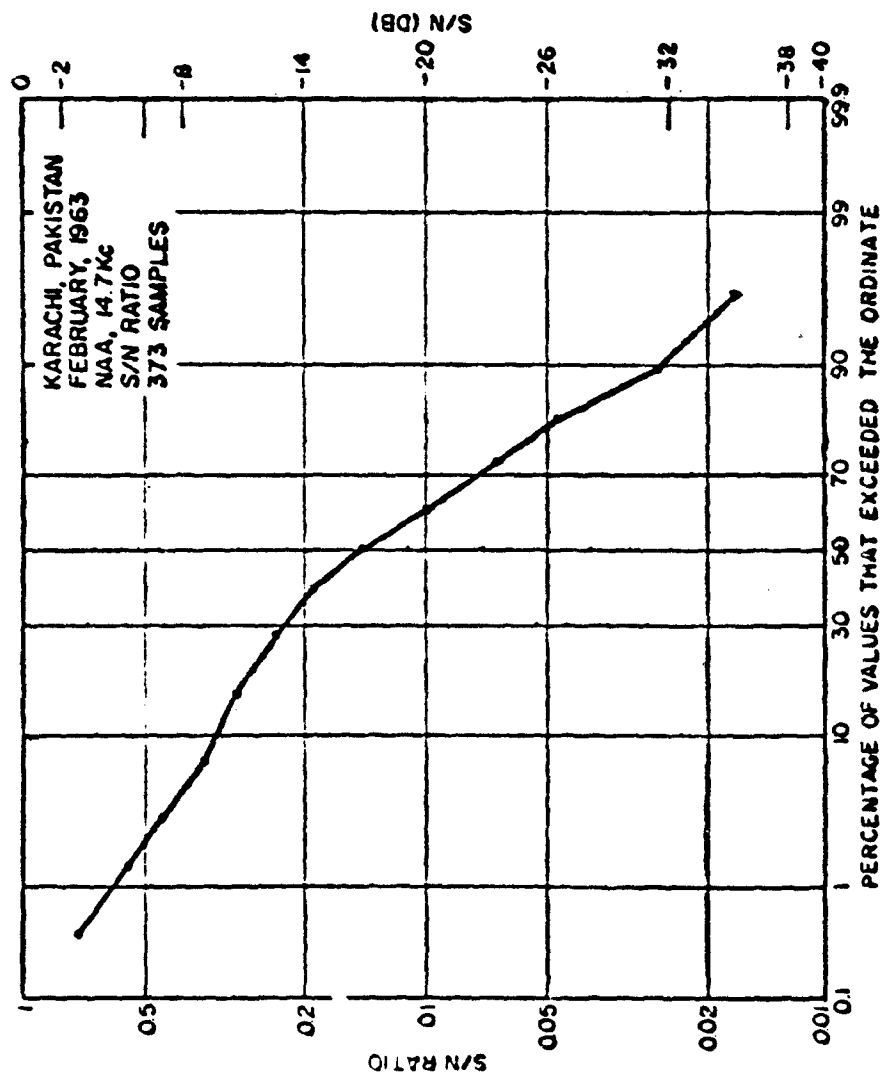


Figure 29a

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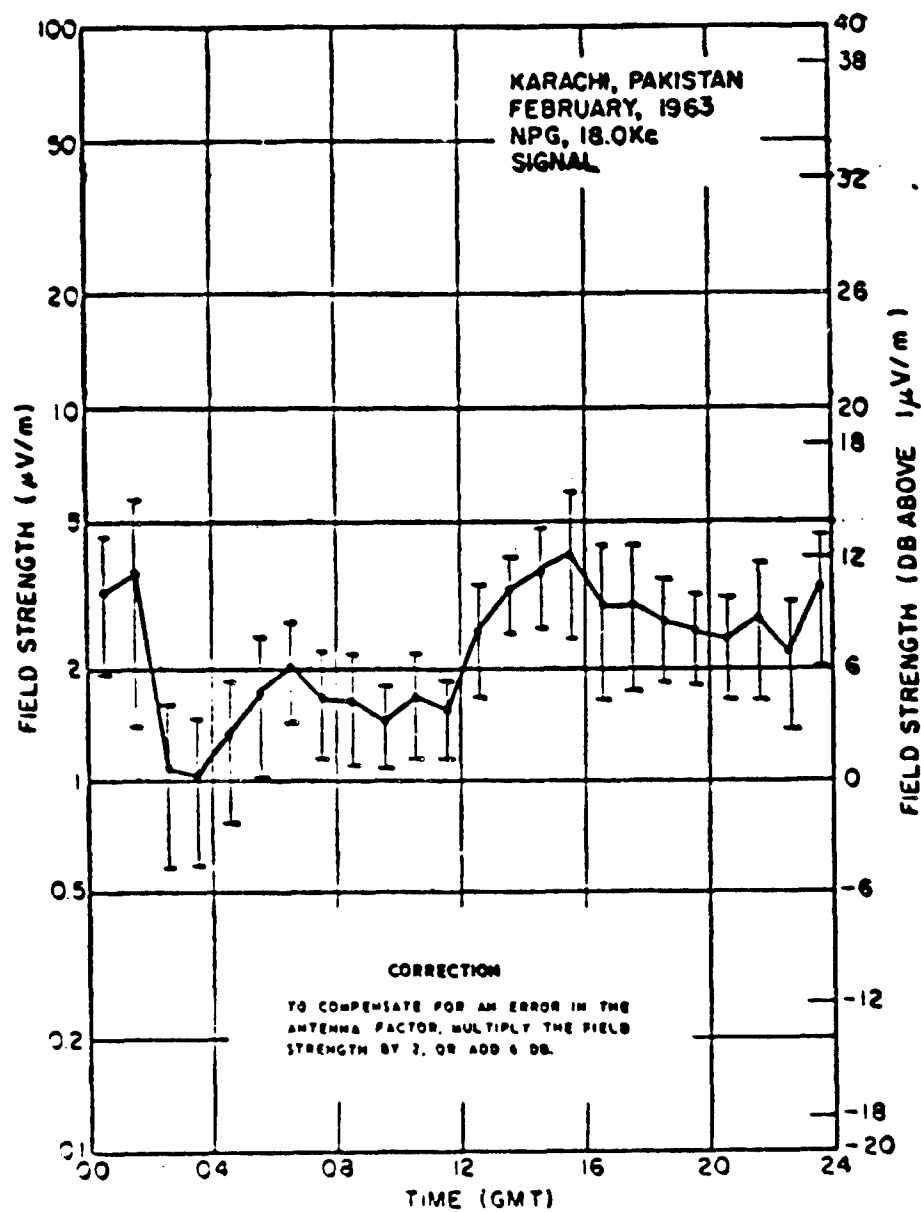


Figure 299

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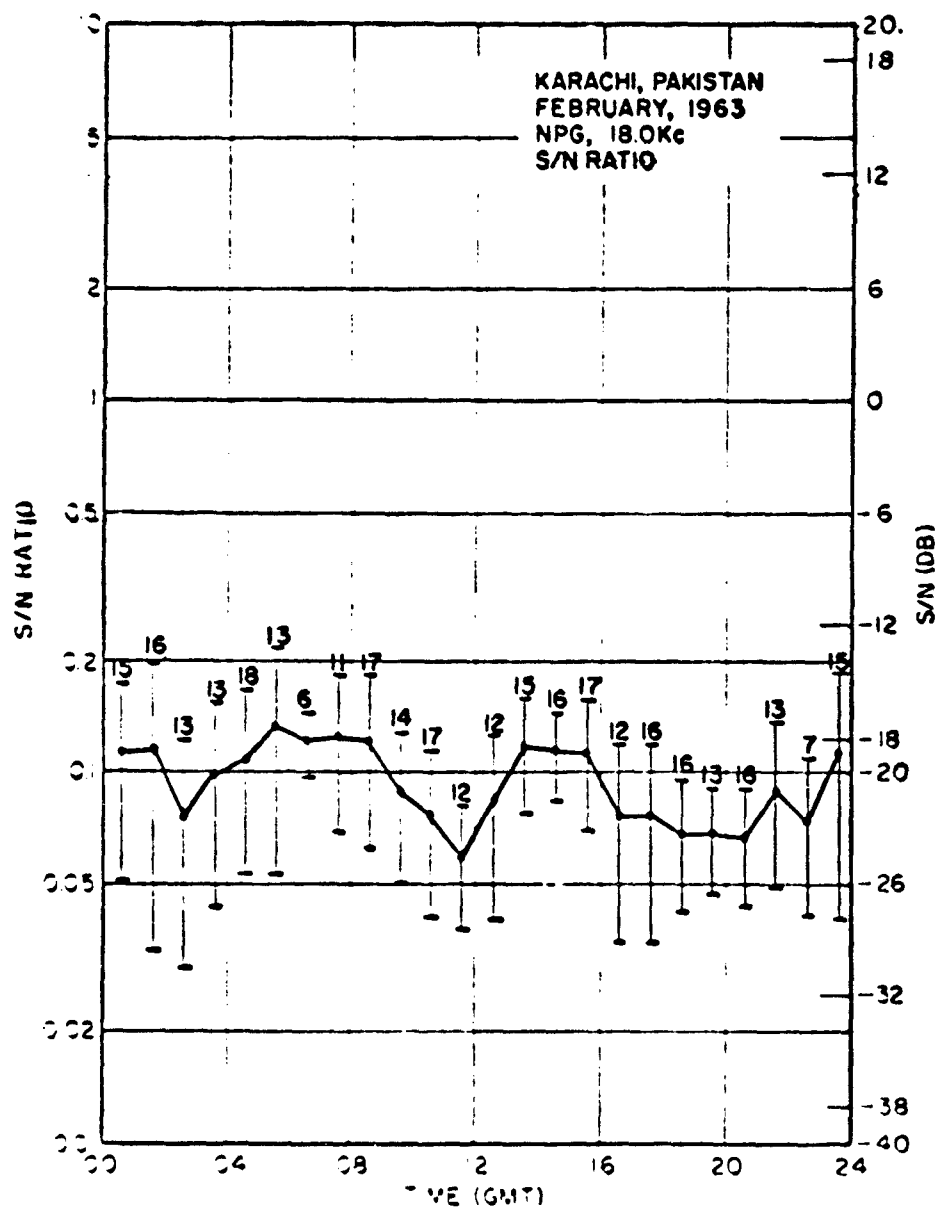


Figure 300

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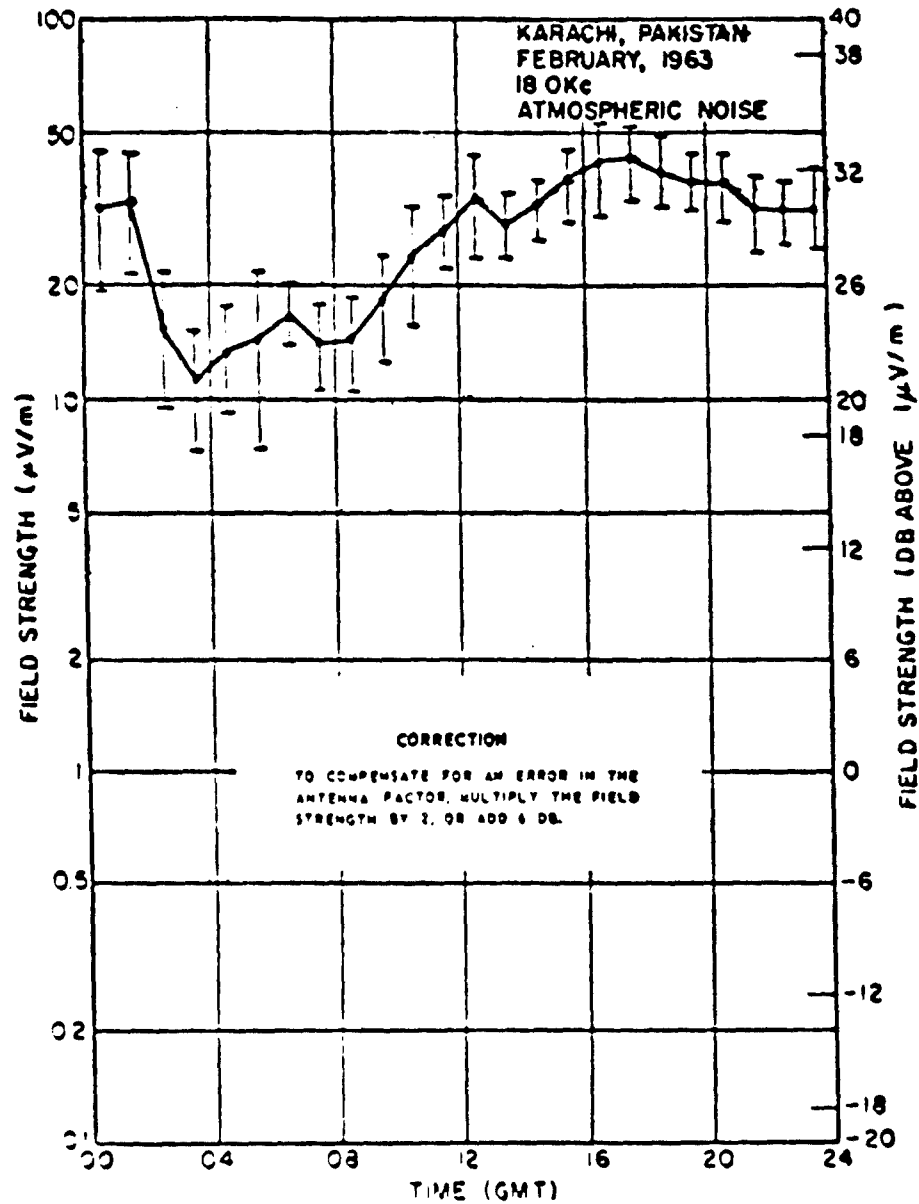


Figure 301

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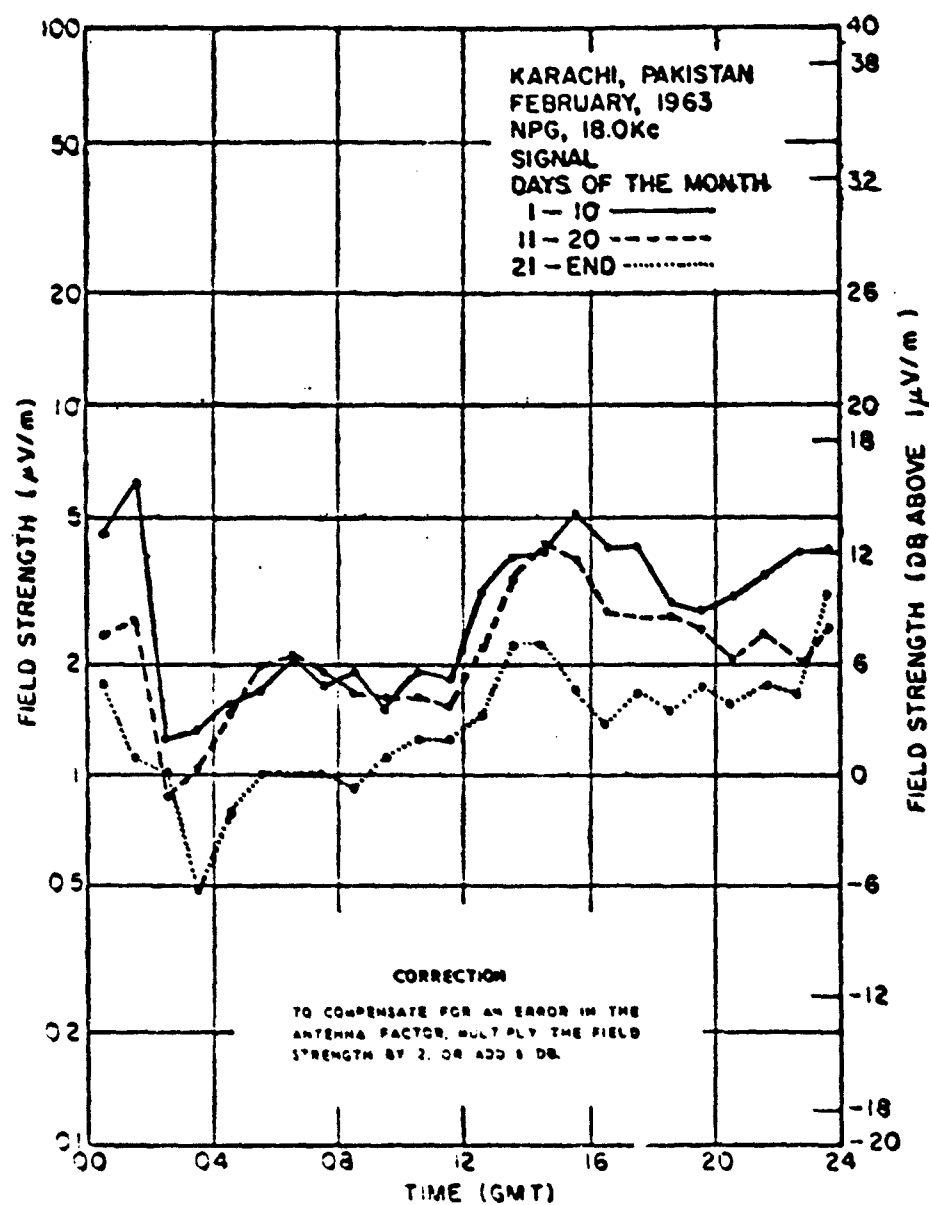


Figure 302

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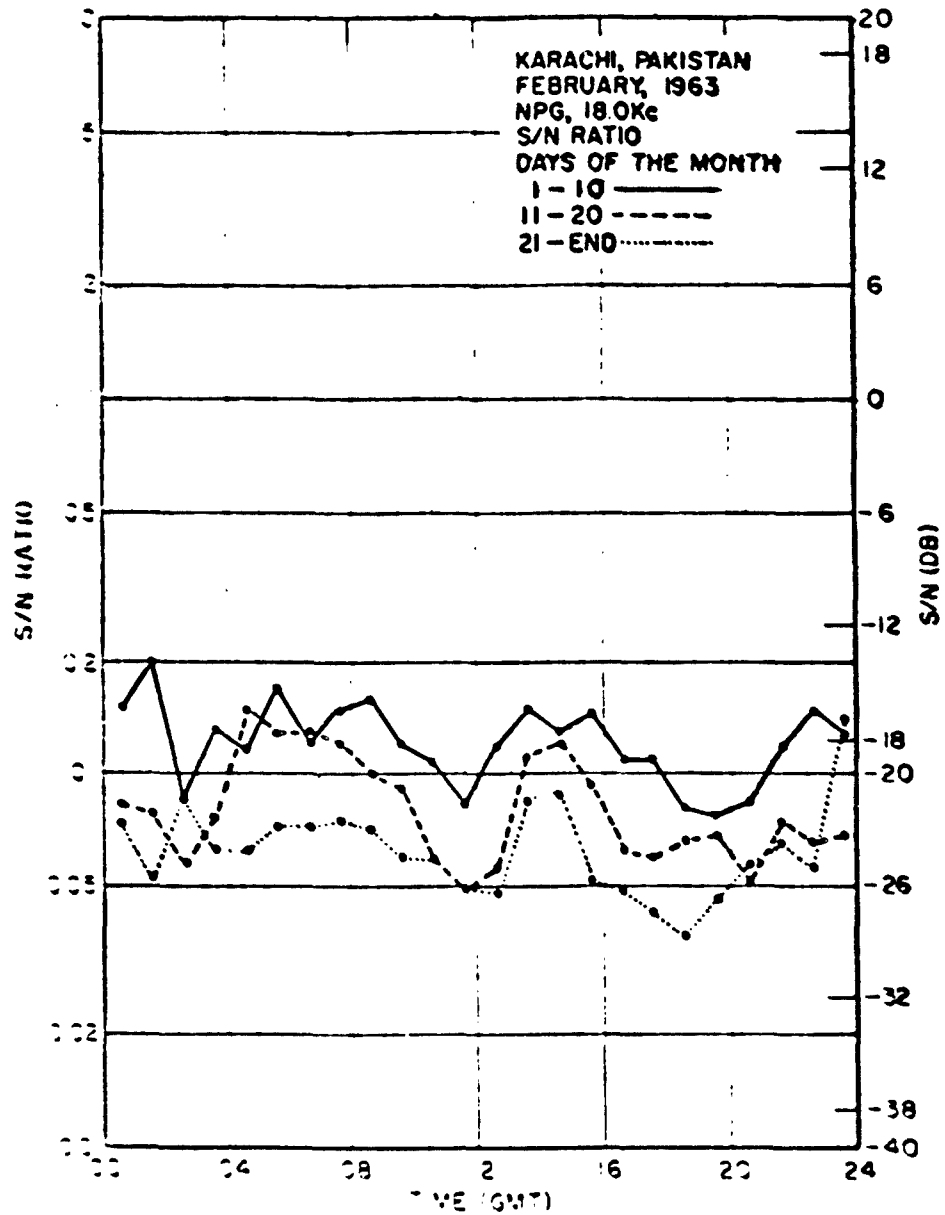


Figure 303

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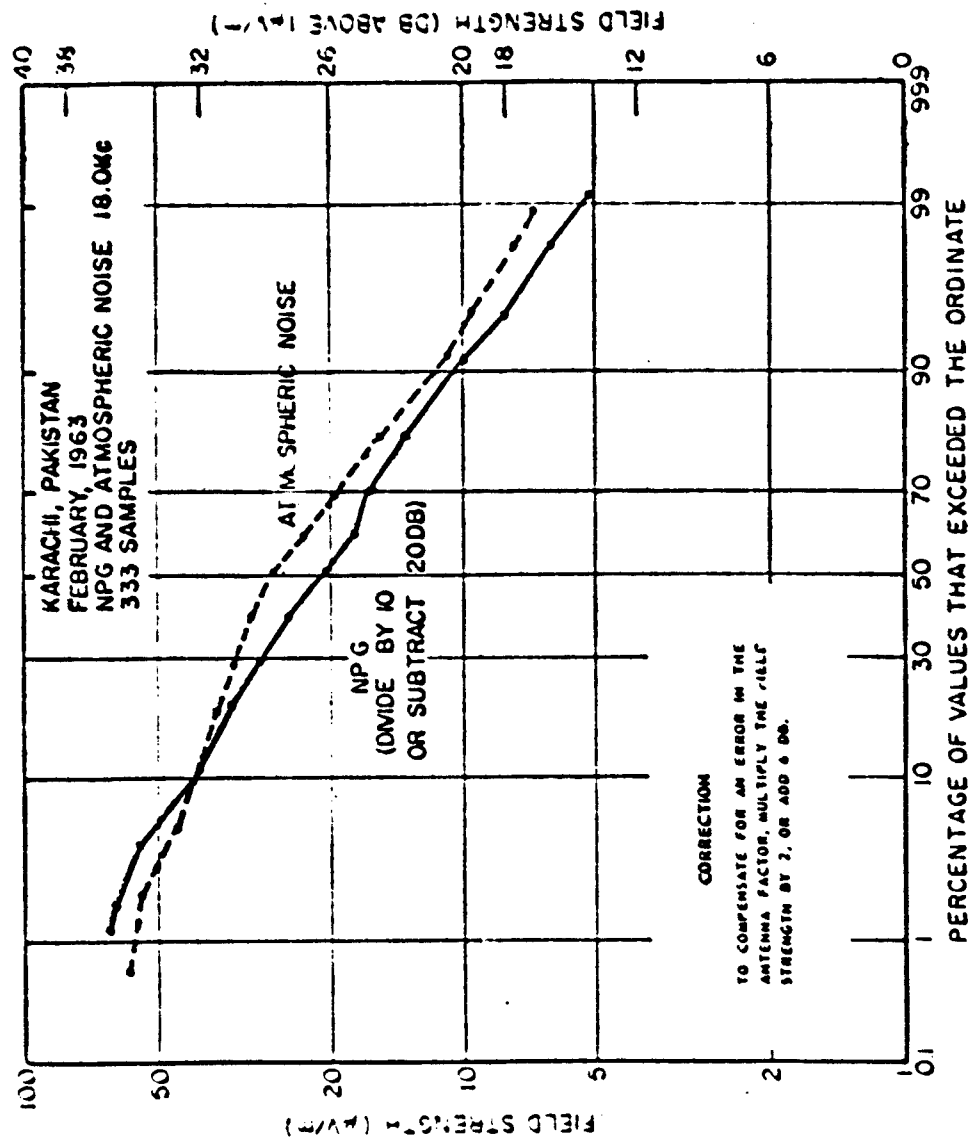


Figure 304

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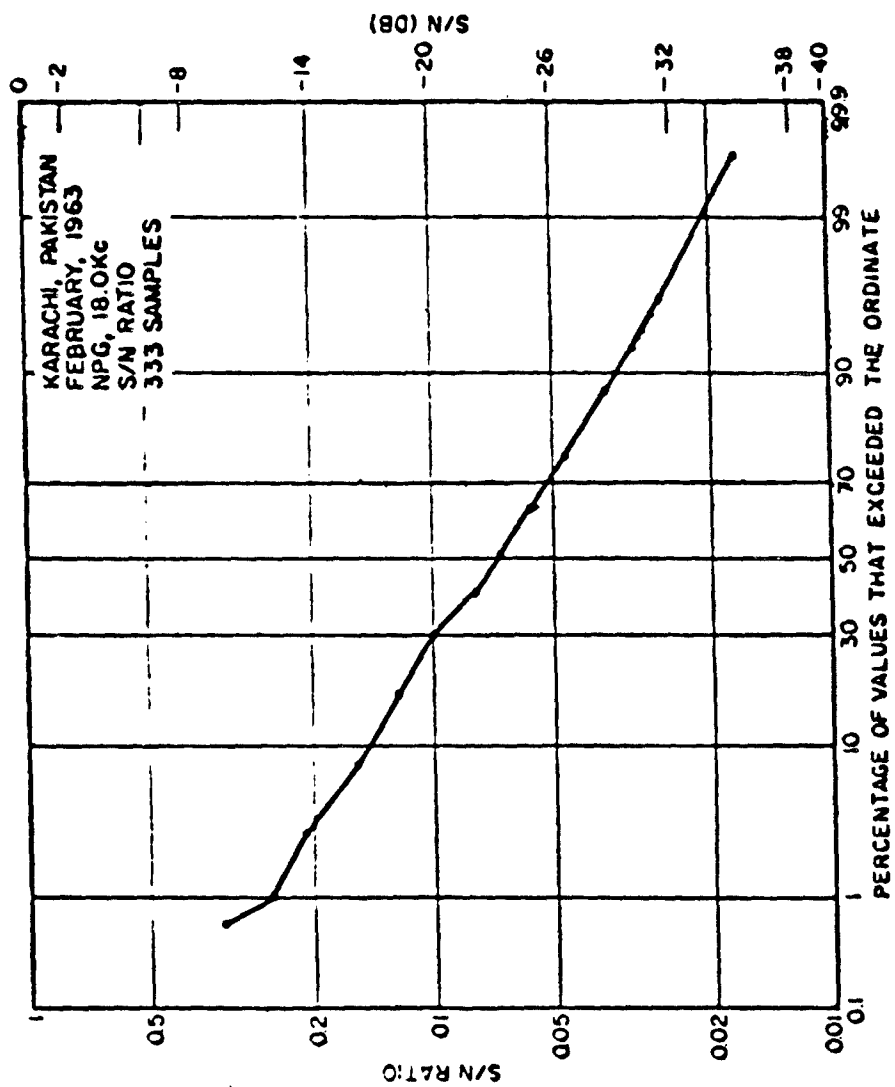


Figure 305

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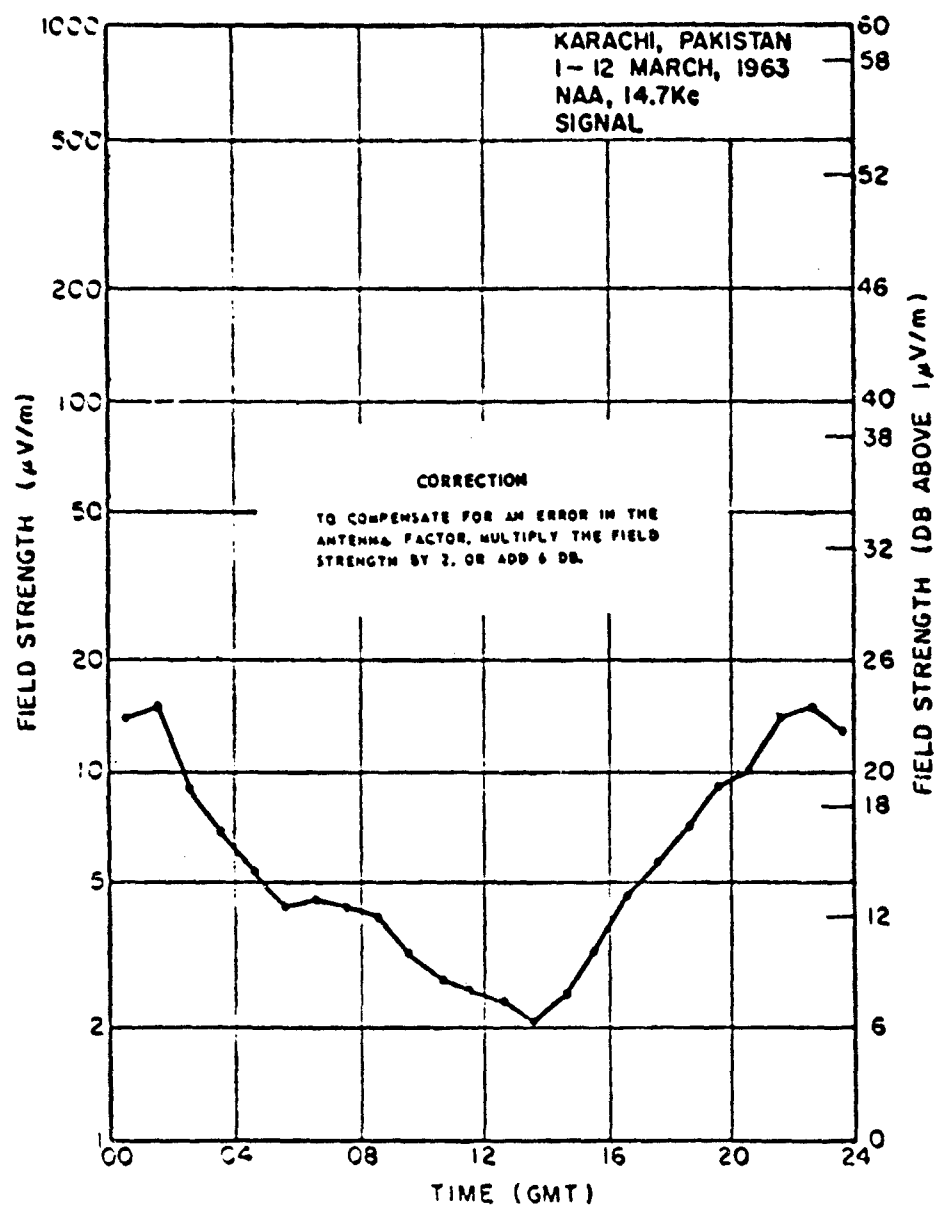


Figure 306

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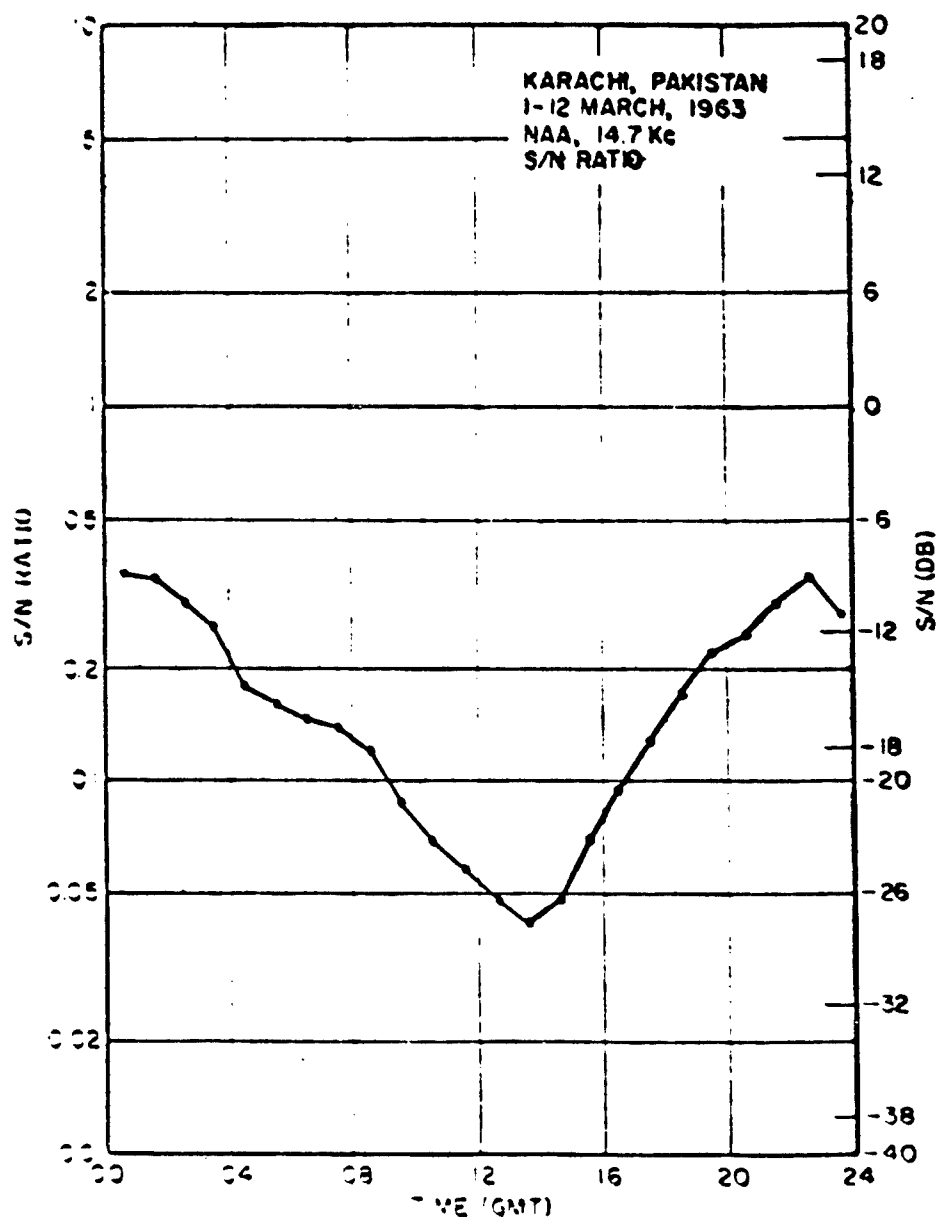


Figure 307

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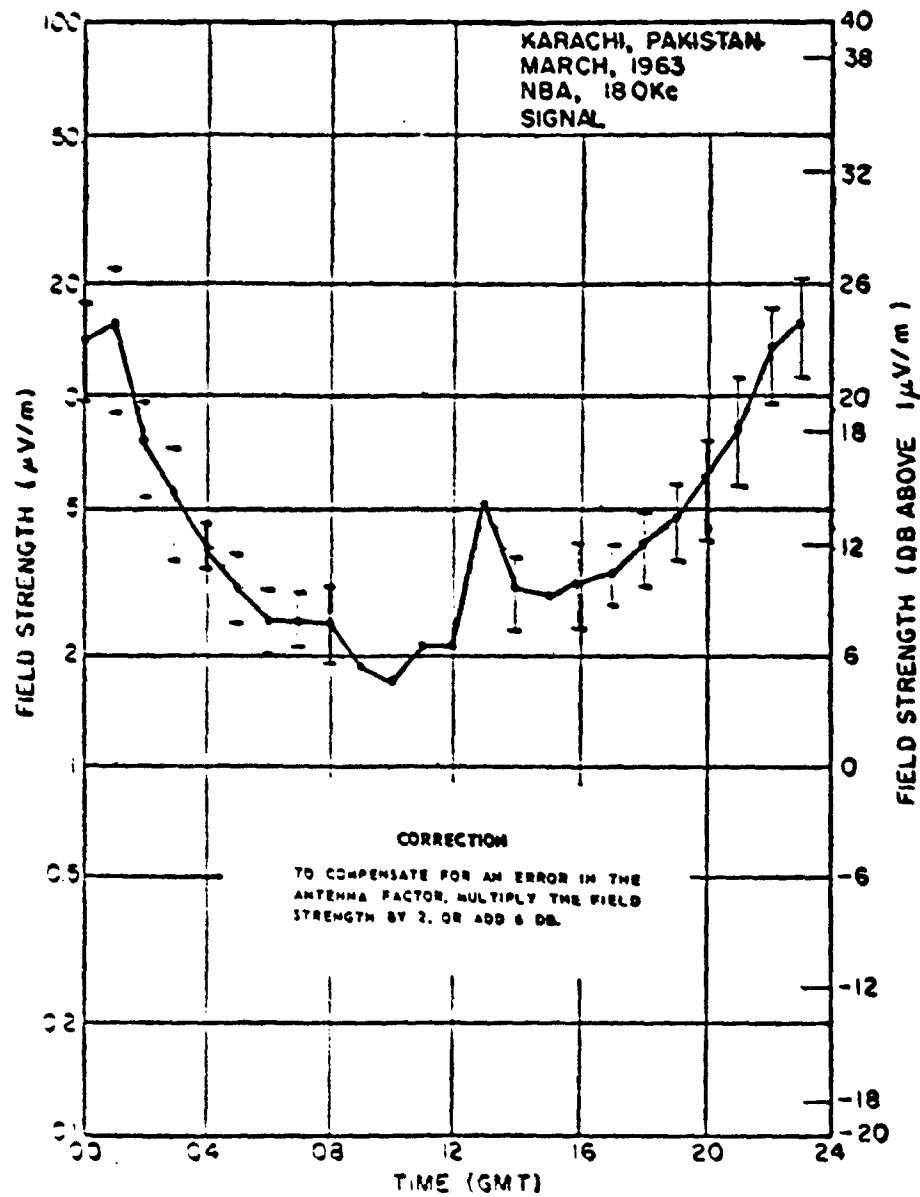


Figure 308

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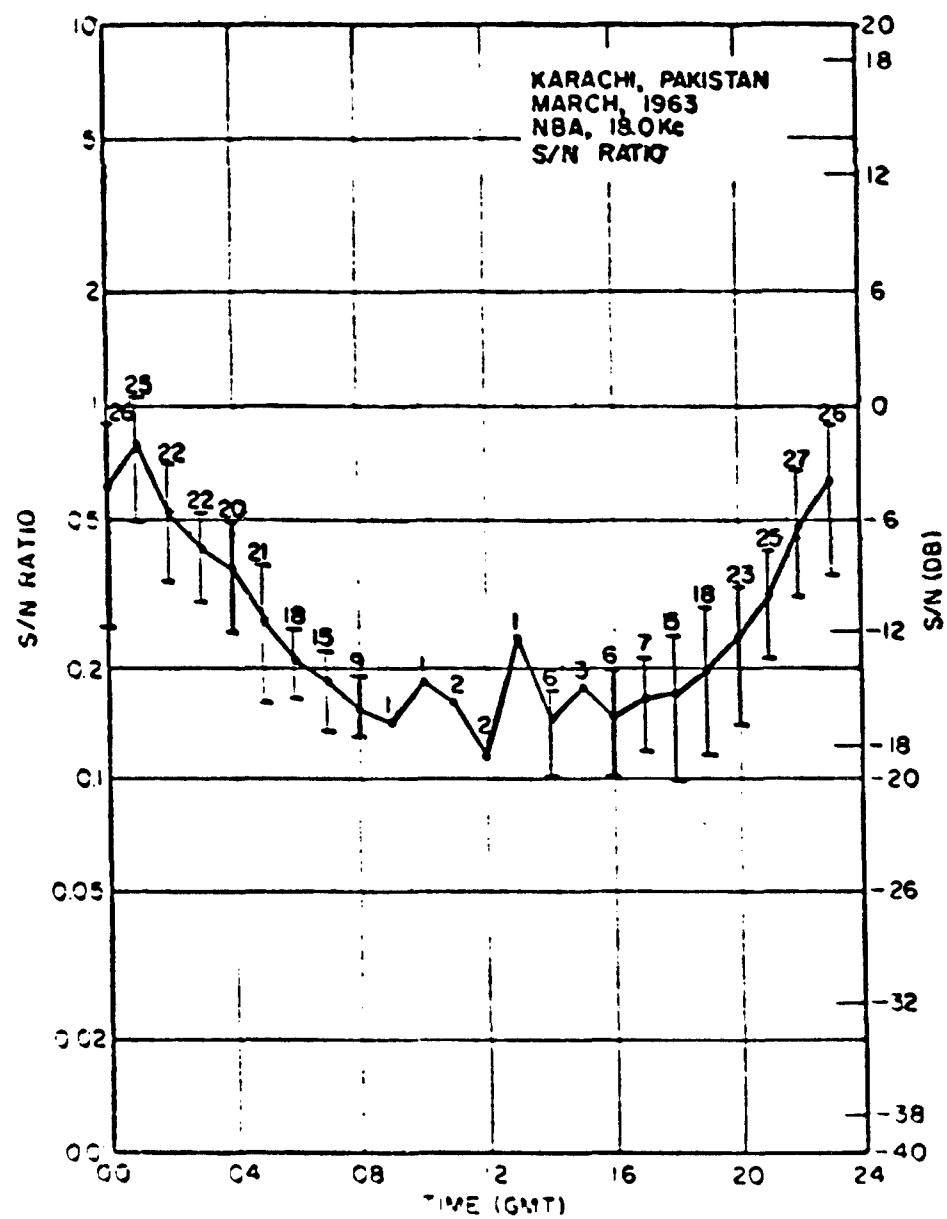


Figure 309

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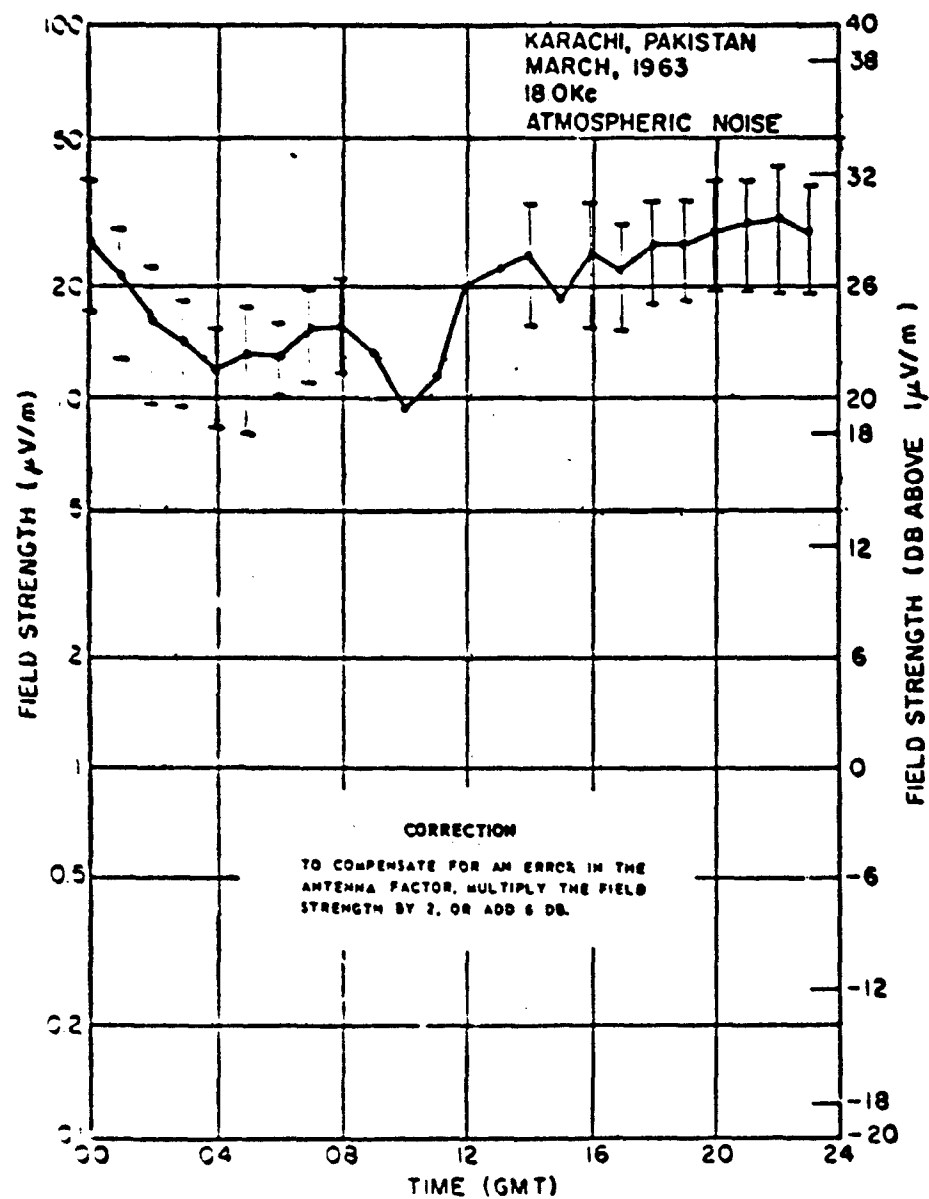


Figure 310

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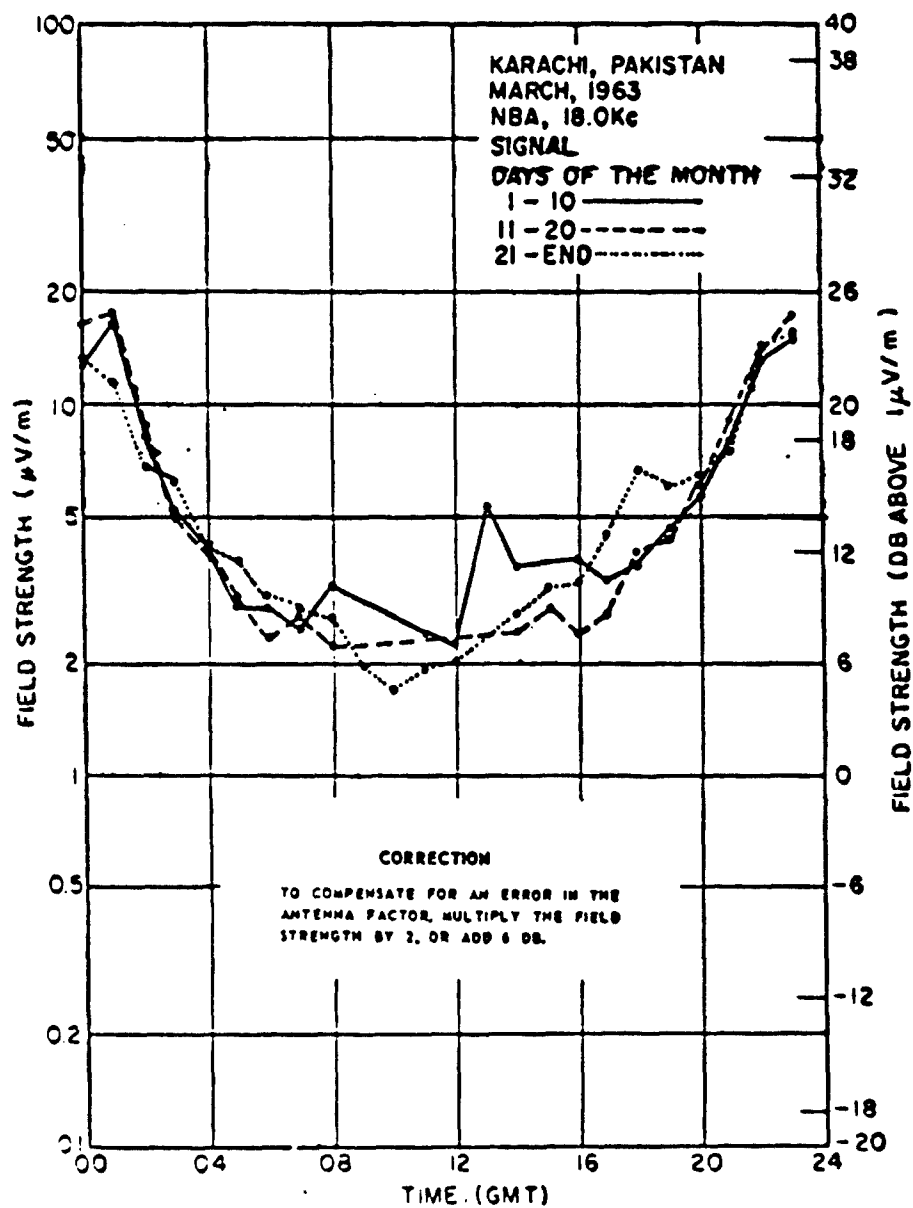


Figure 311

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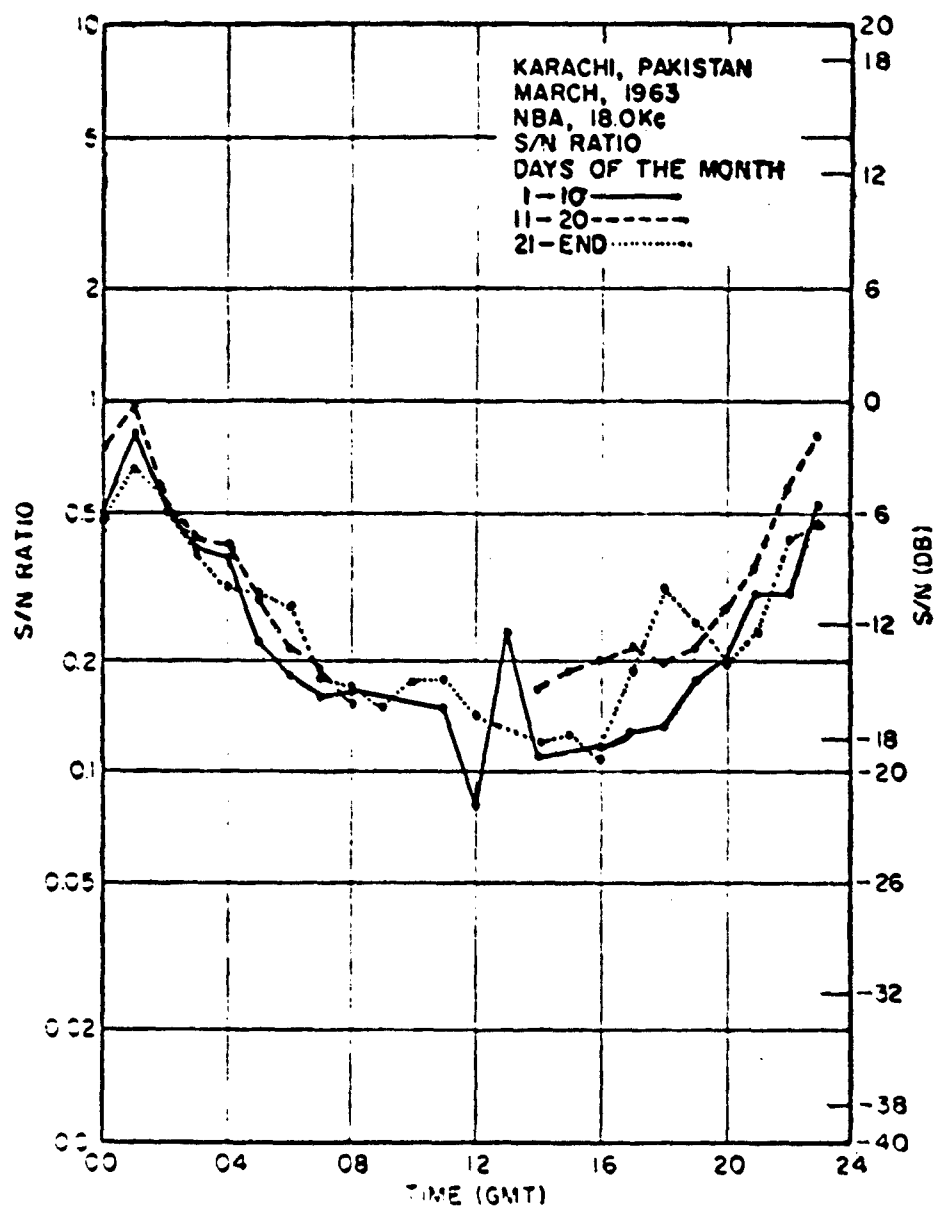


Figure 312

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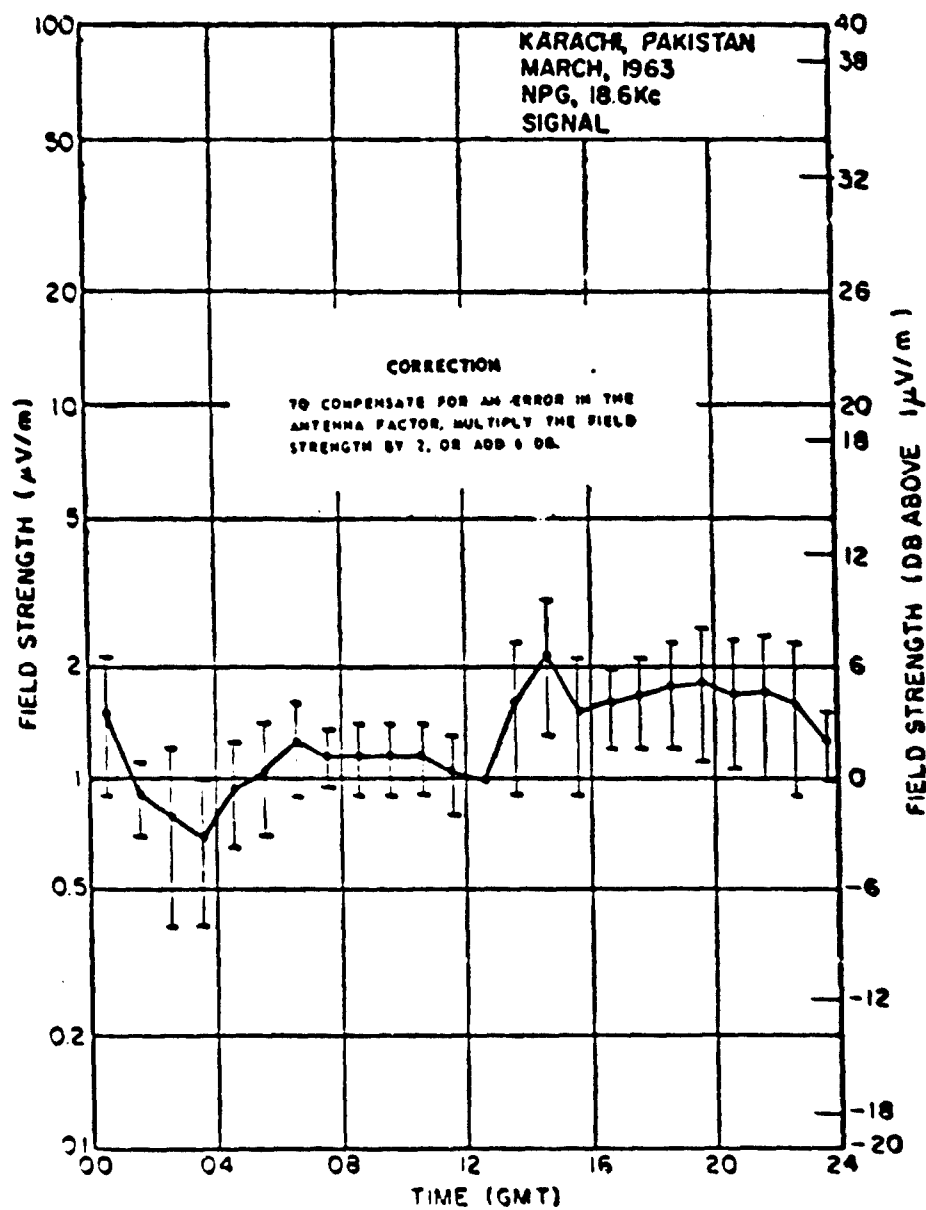


Figure 313

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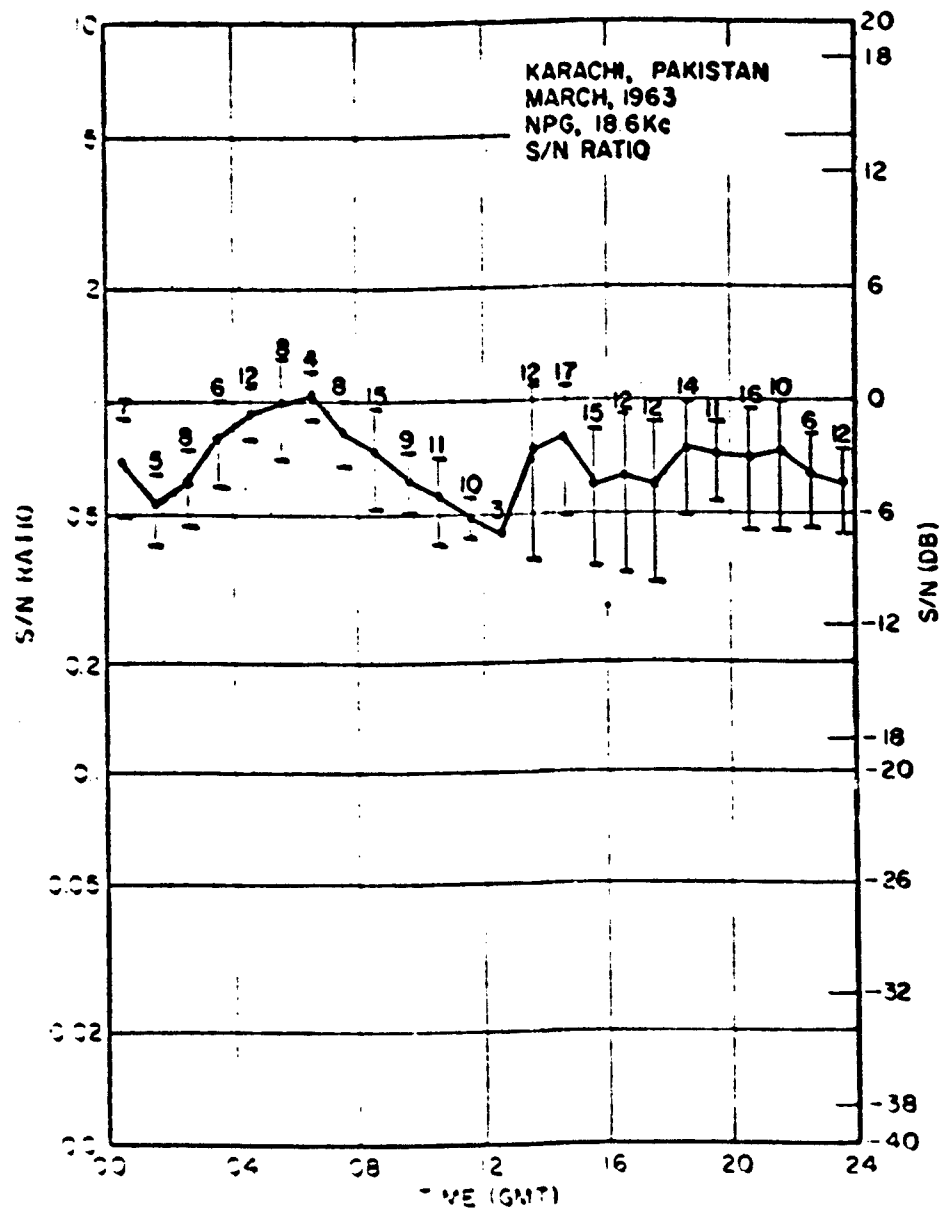


Figure 314

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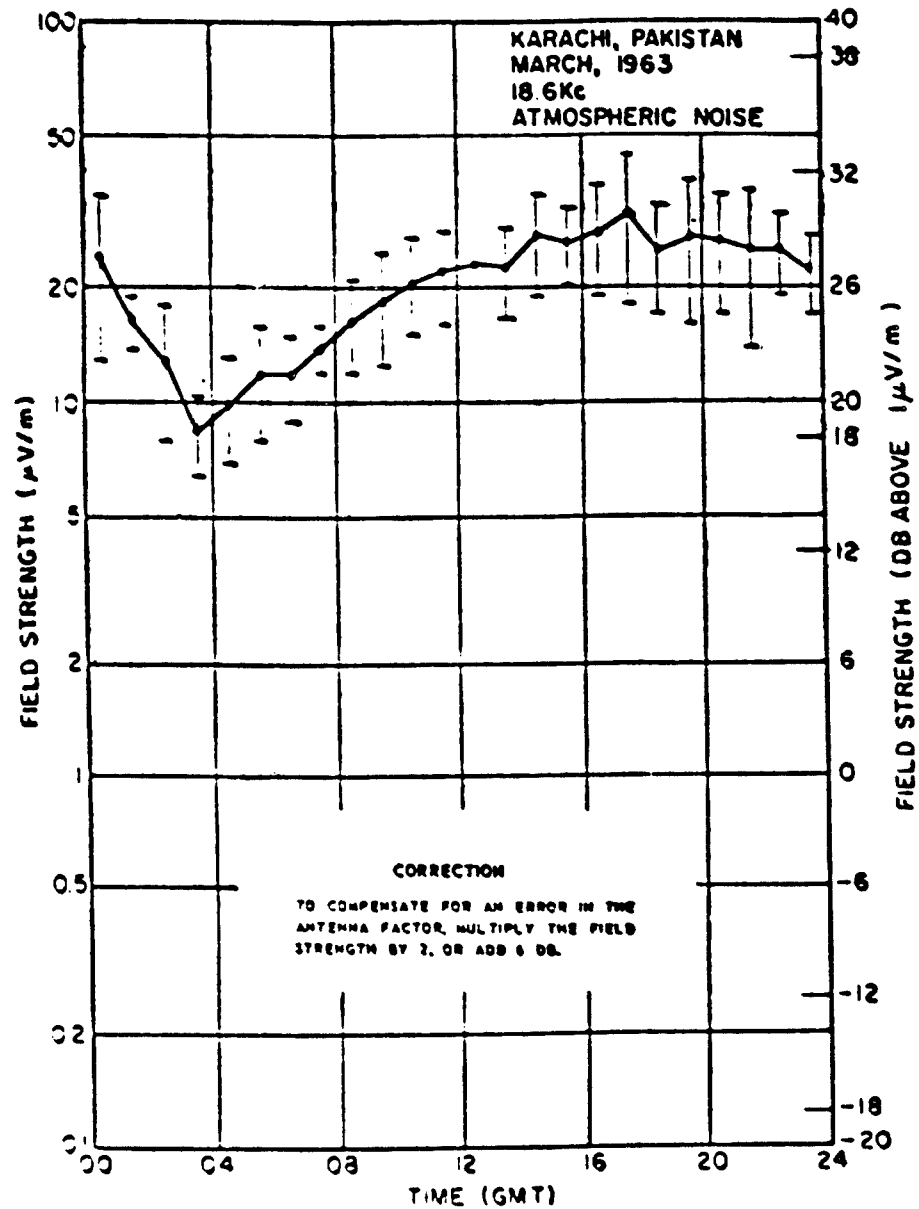


Figure 315

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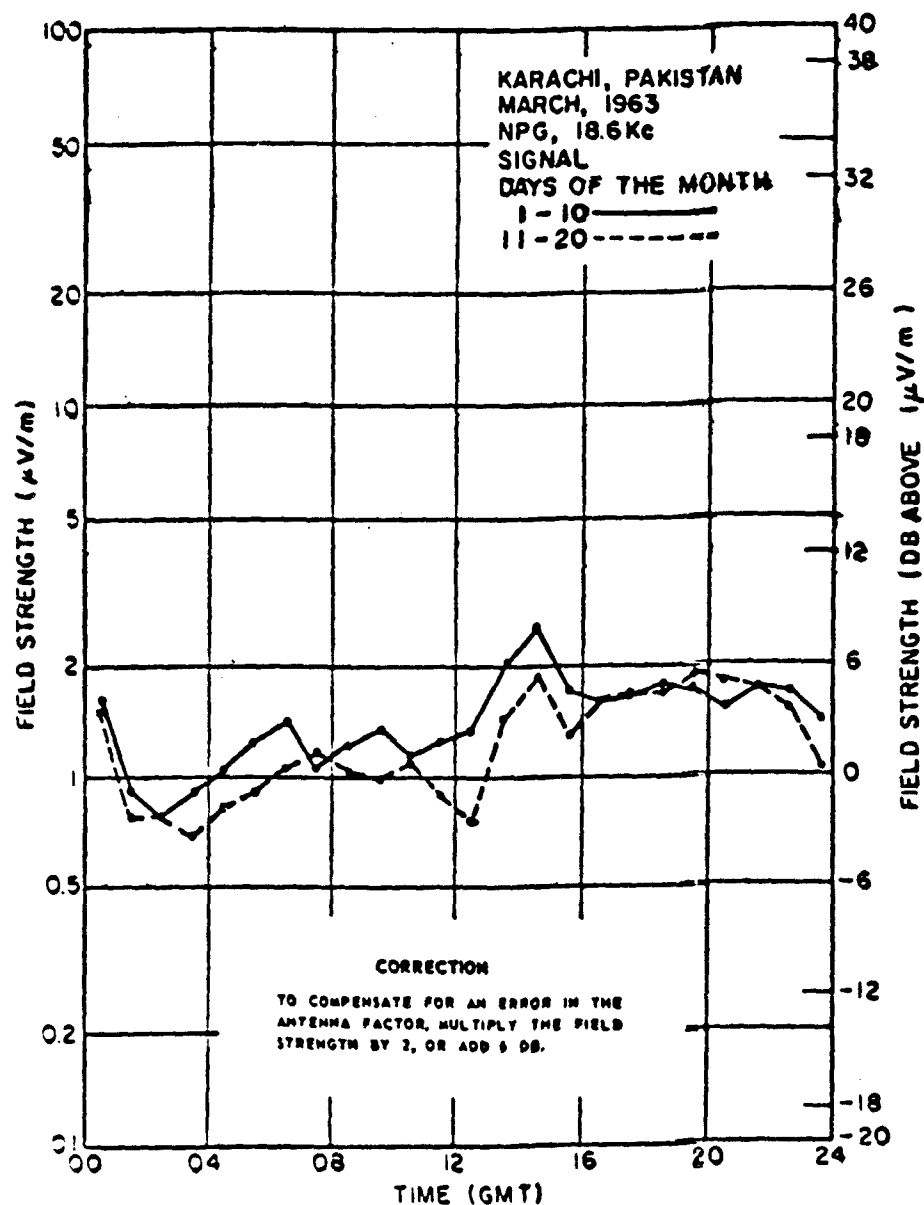


Figure 316

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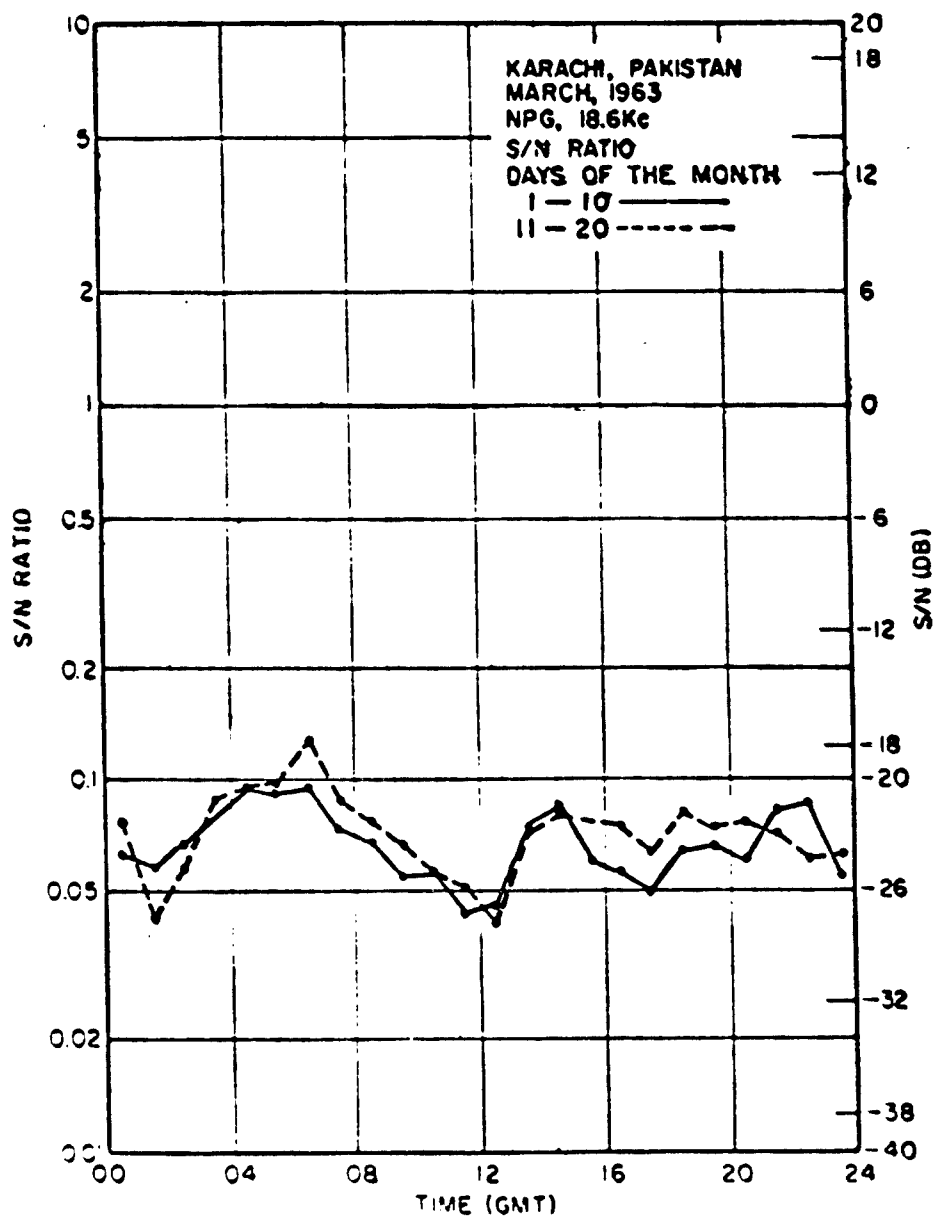


Figure 317

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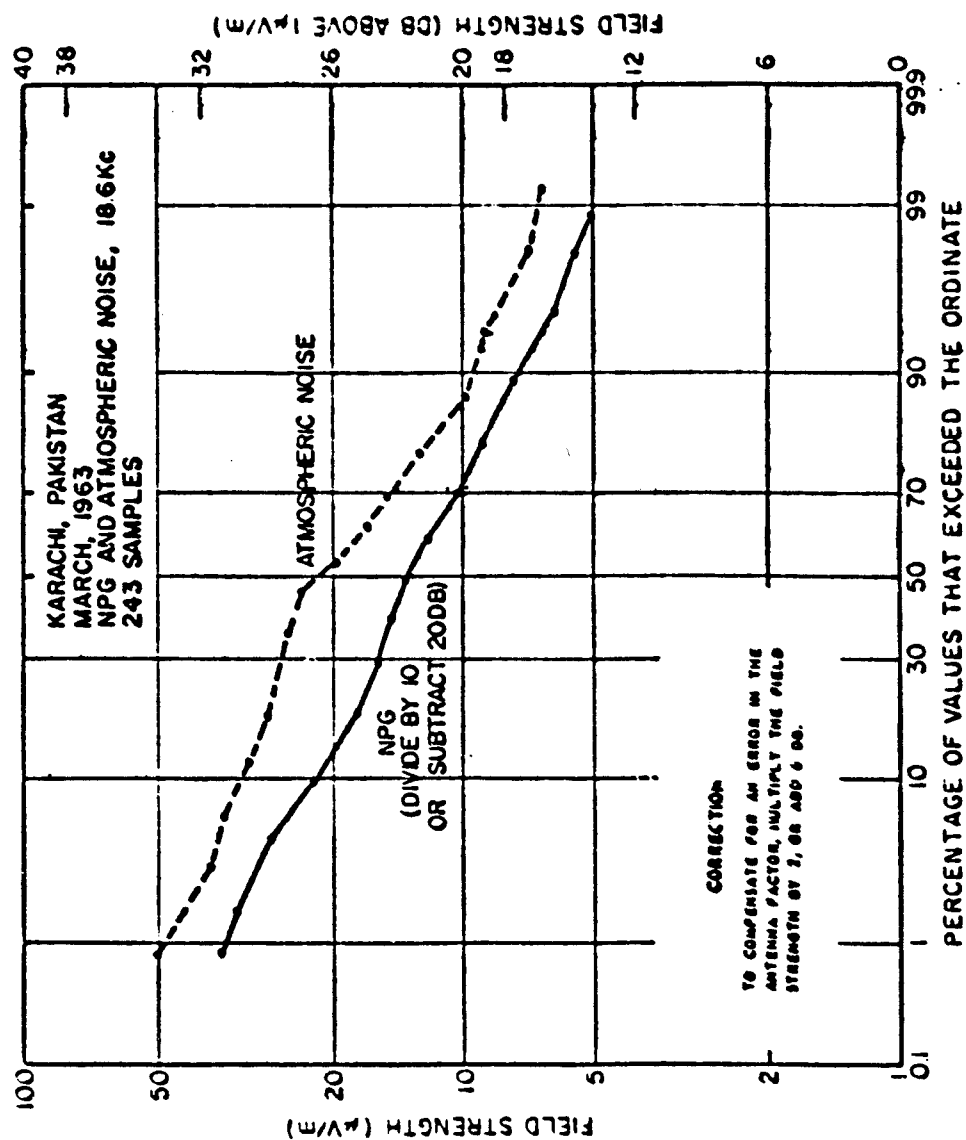


Figure 318

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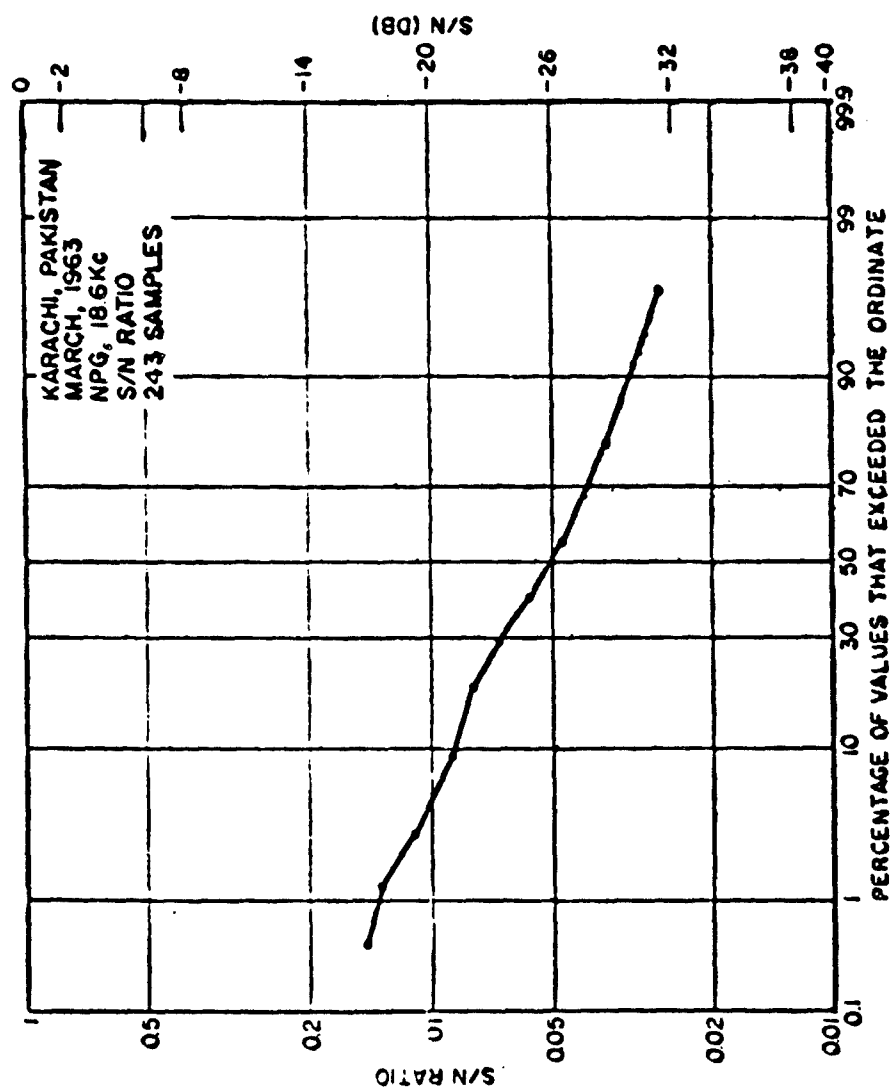


Figure 319

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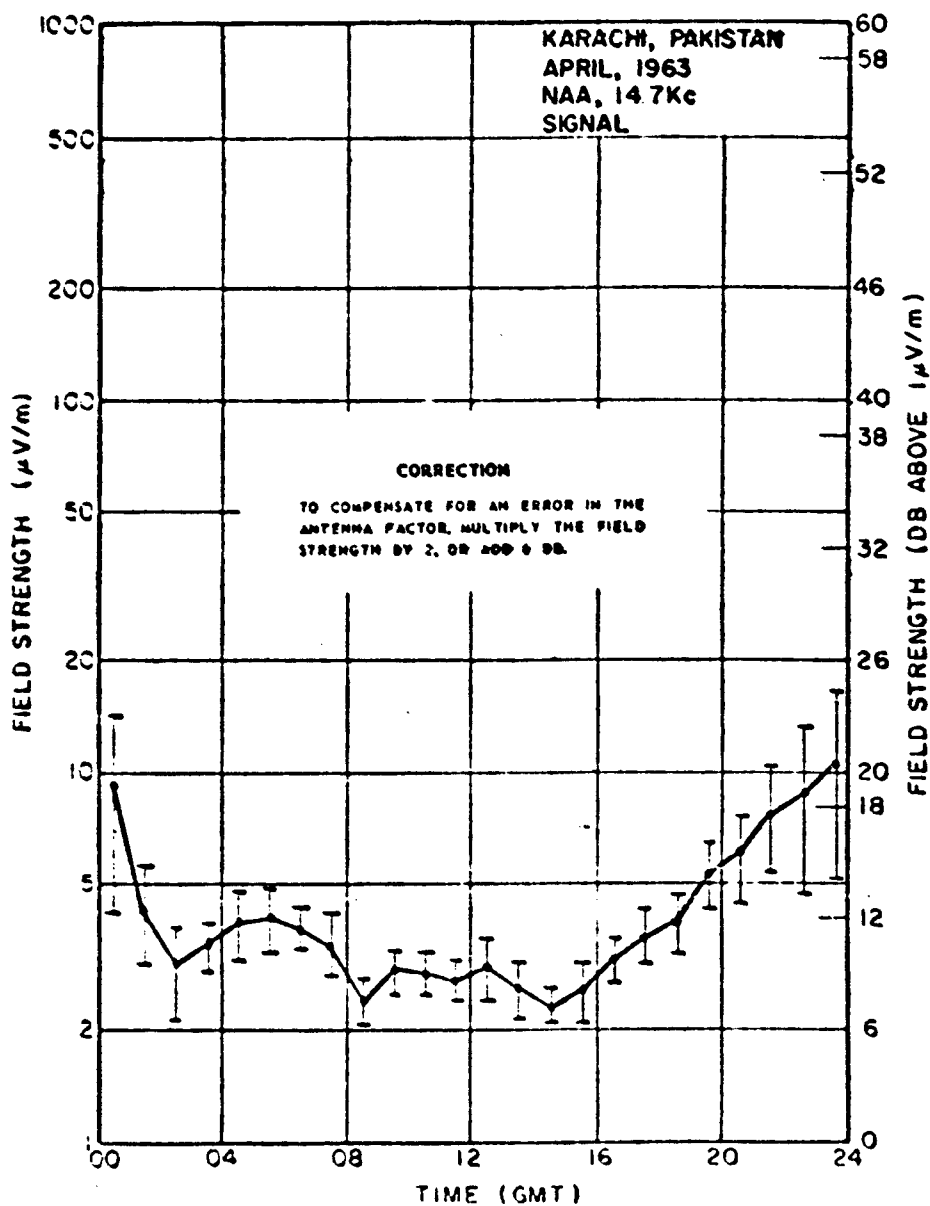


Figure 320

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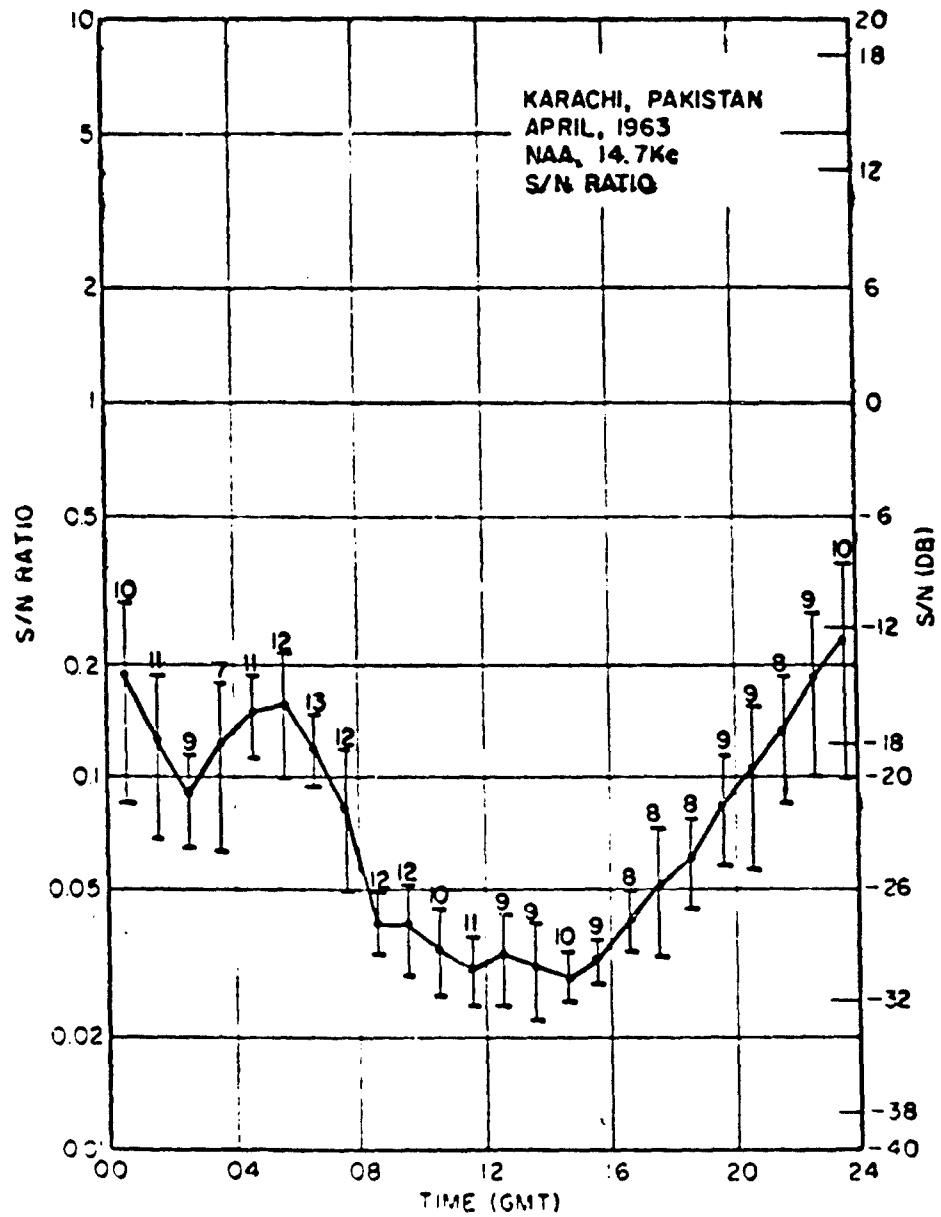


Figure 321

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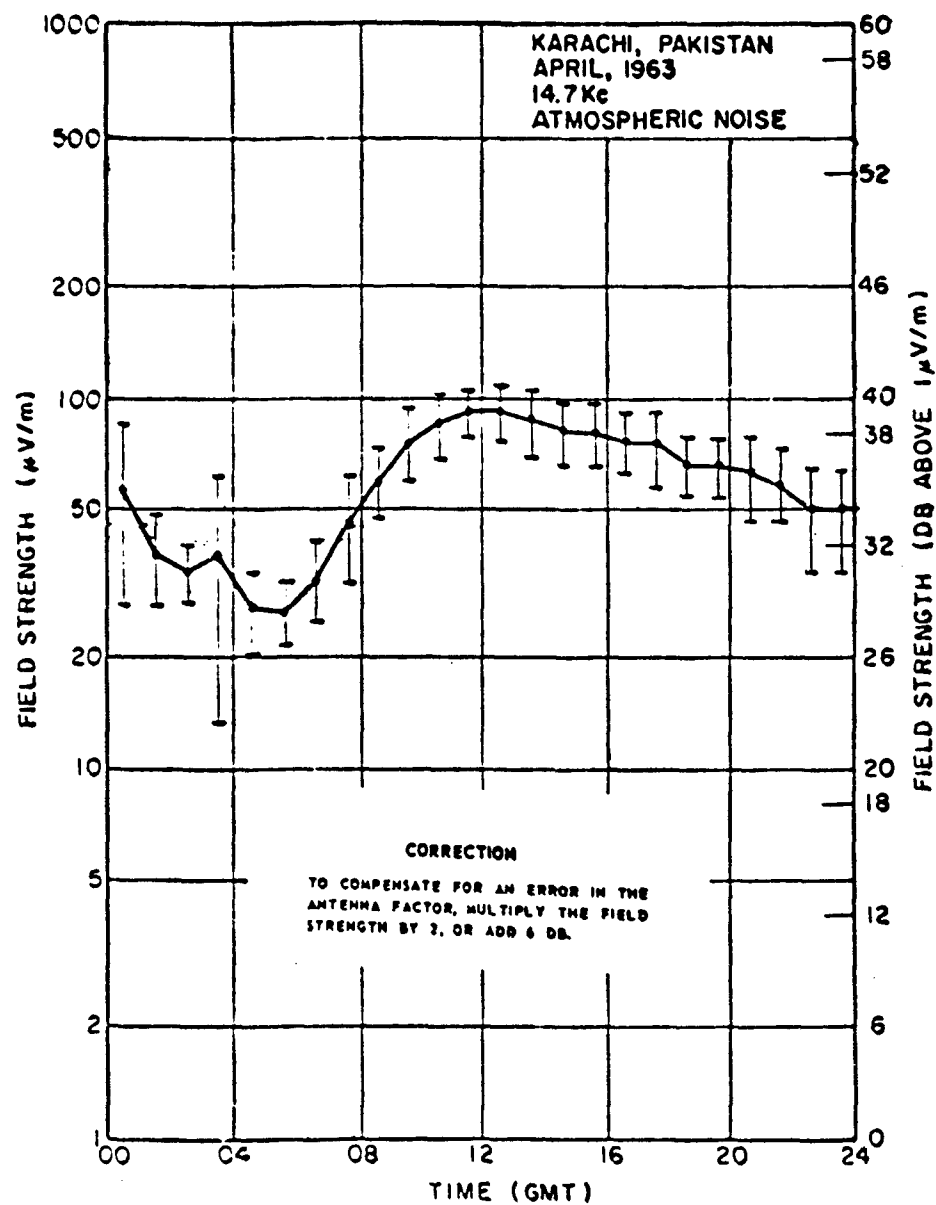


Figure 322

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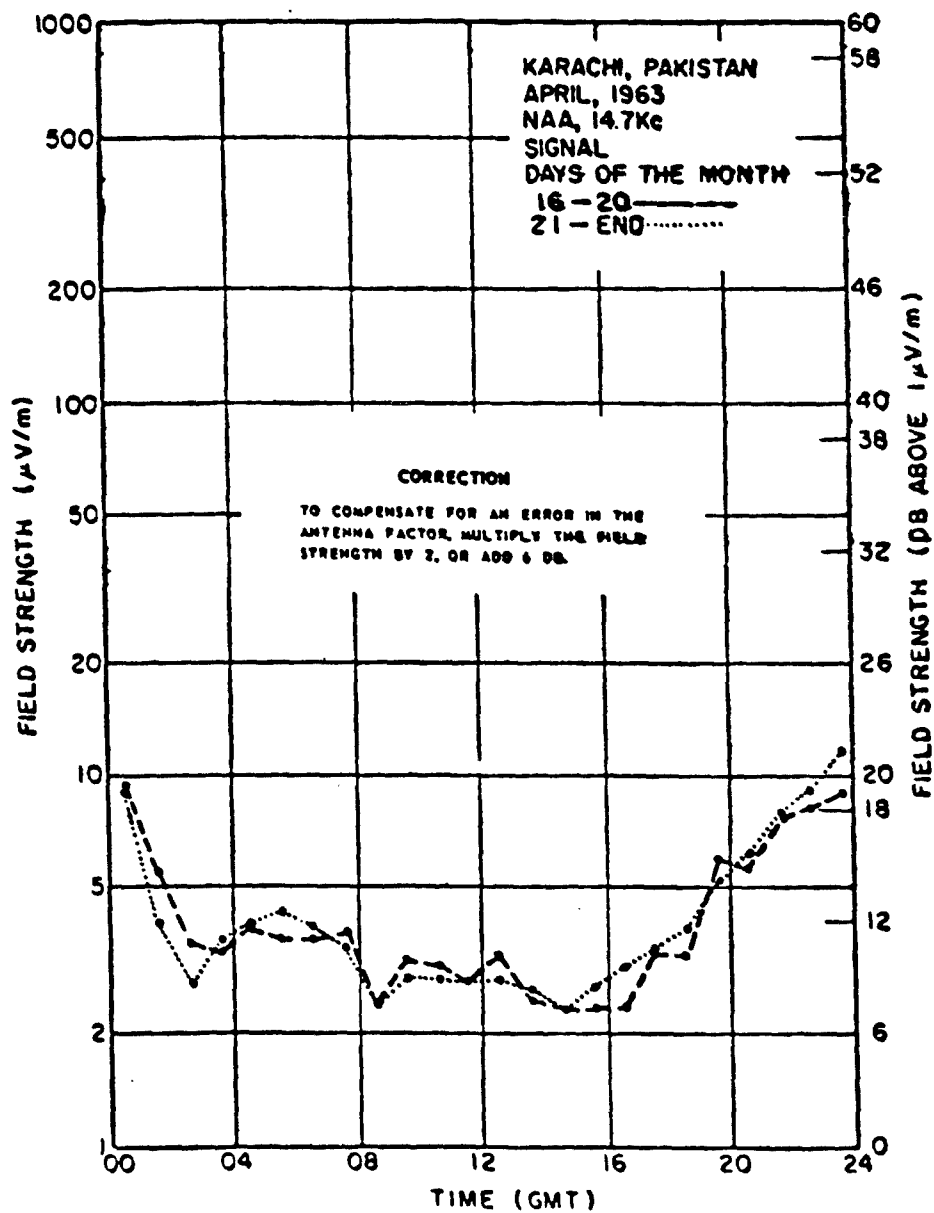


Figure 323

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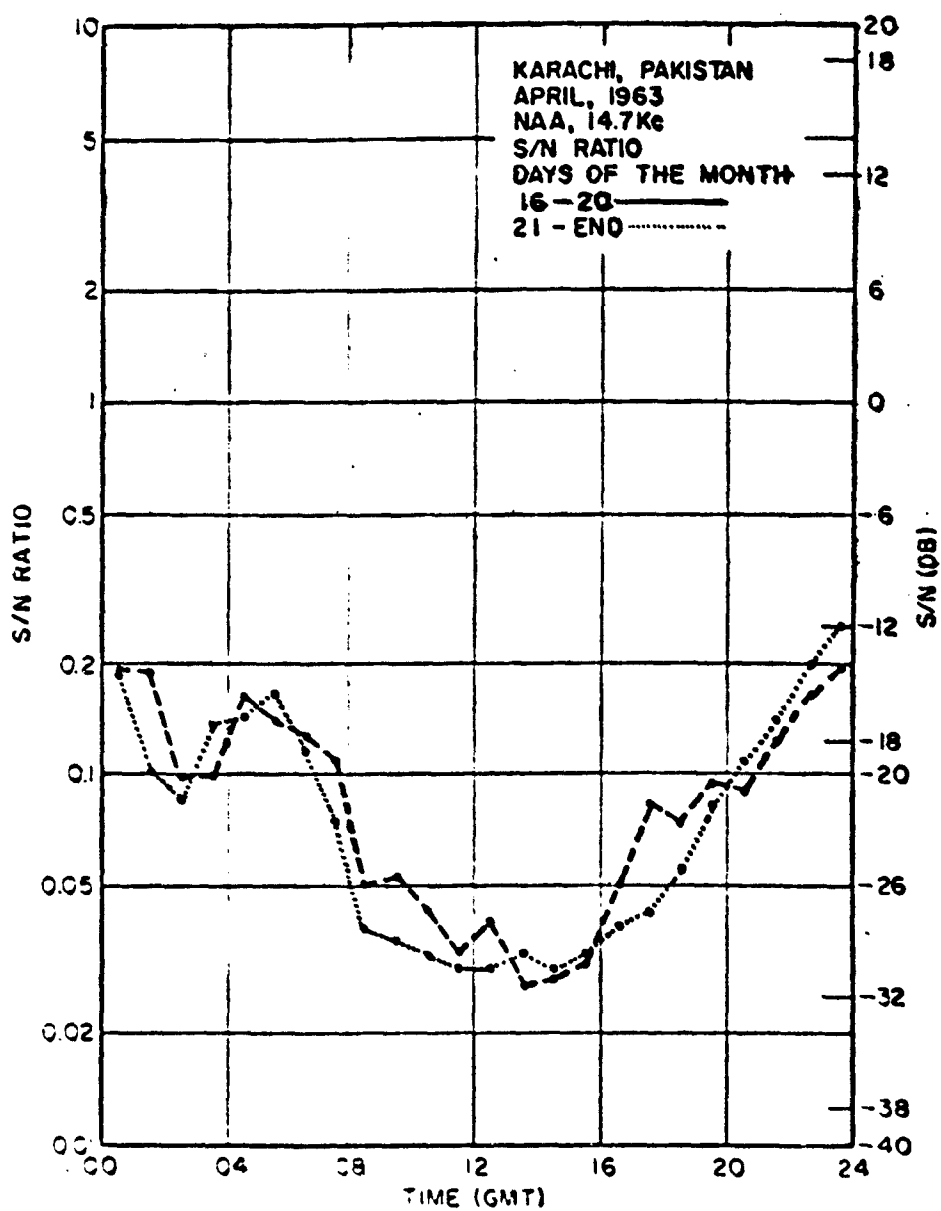


Figure 324

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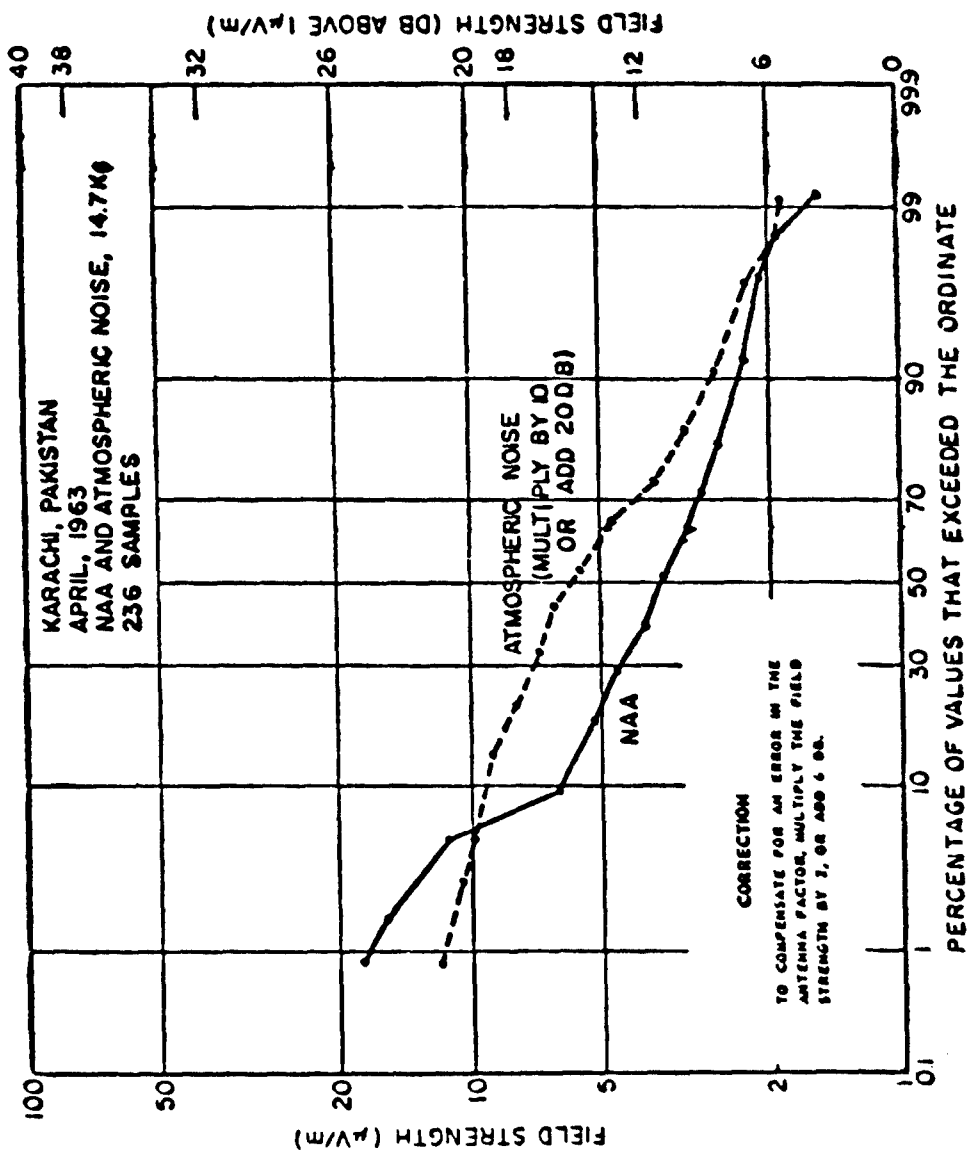


Figure 325

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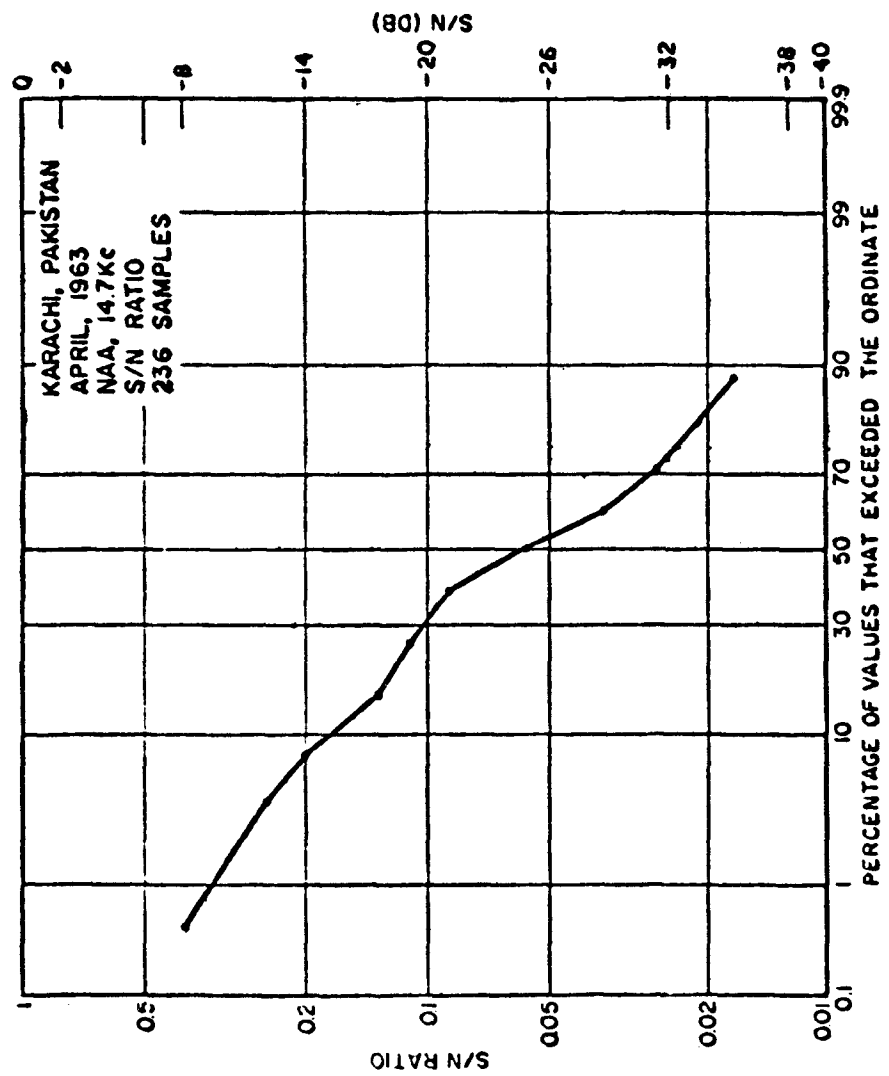


Figure 326

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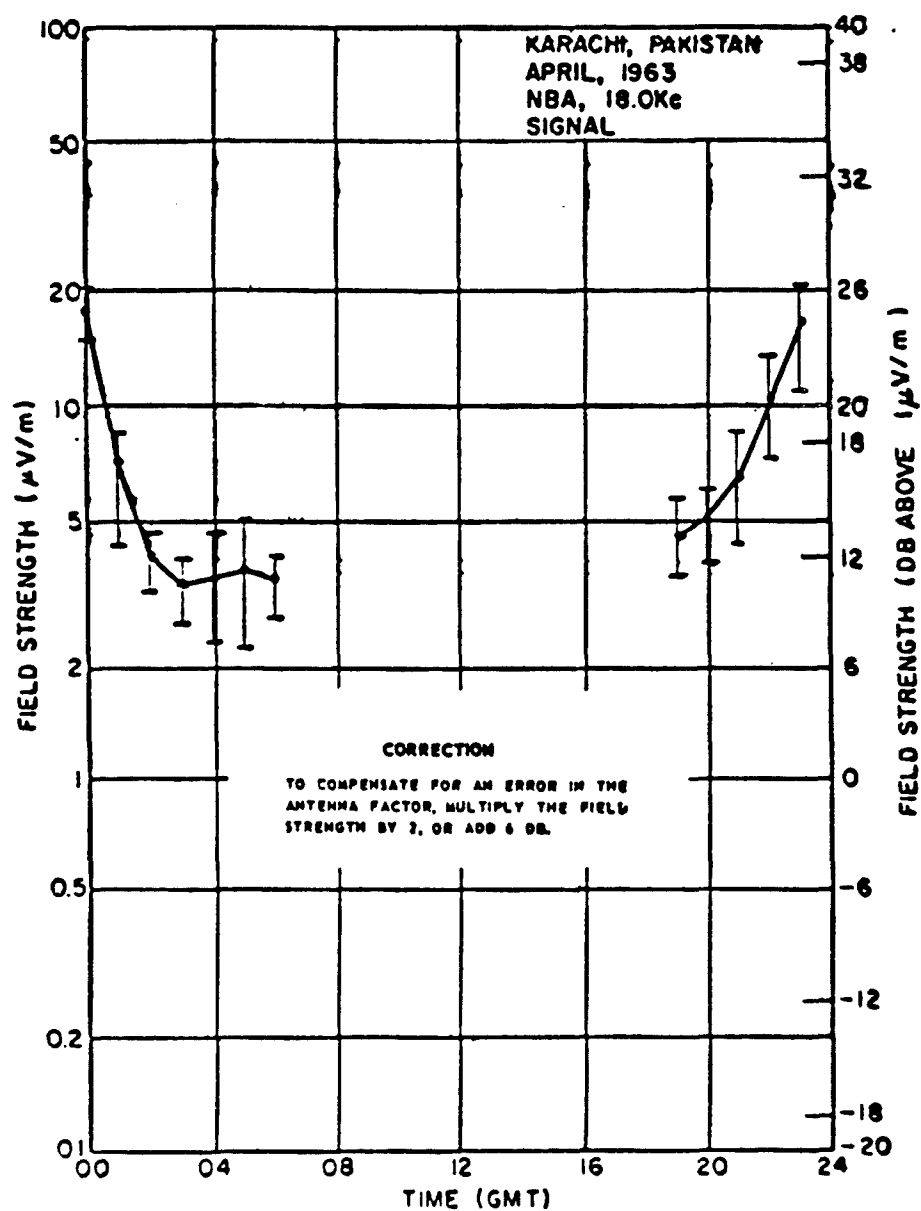


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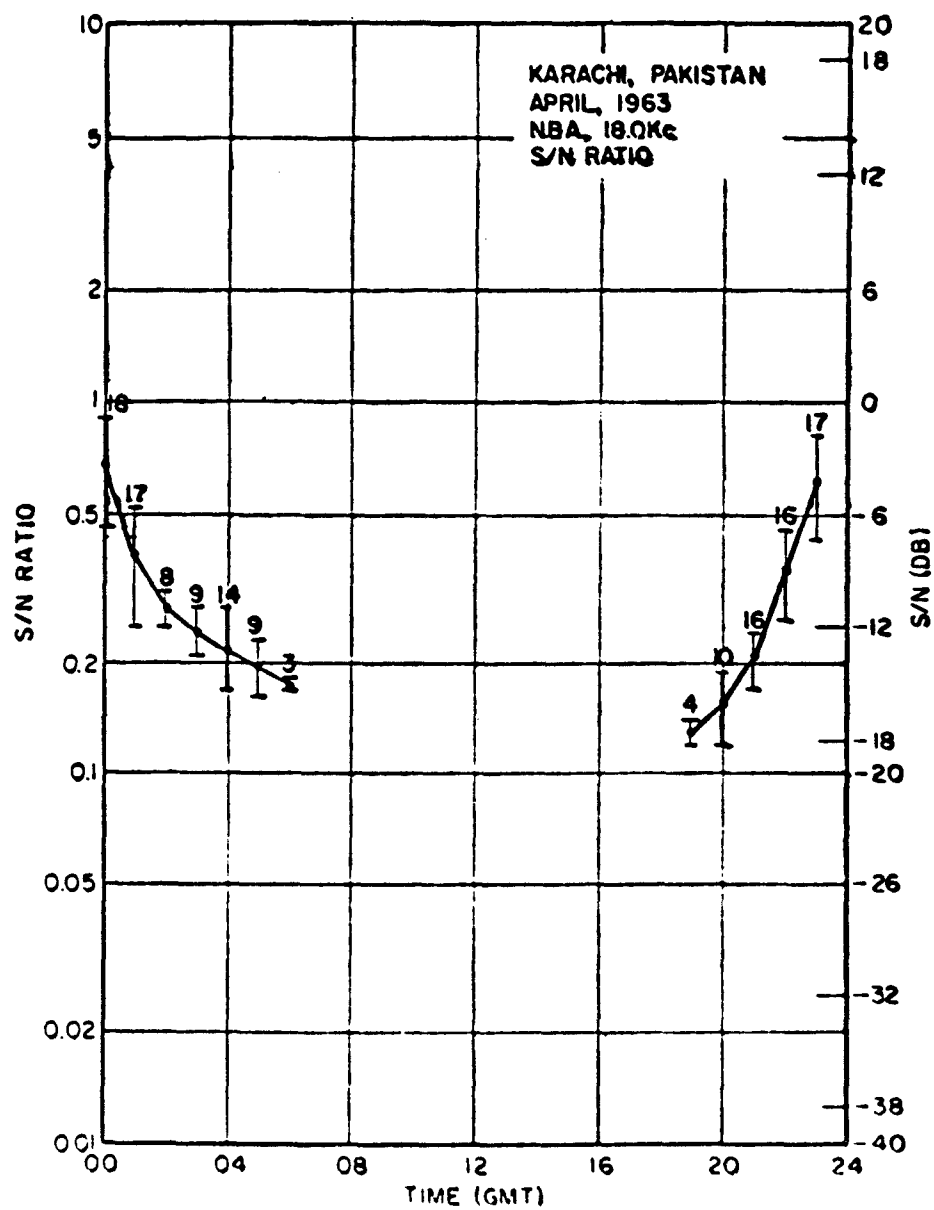


Figure 328

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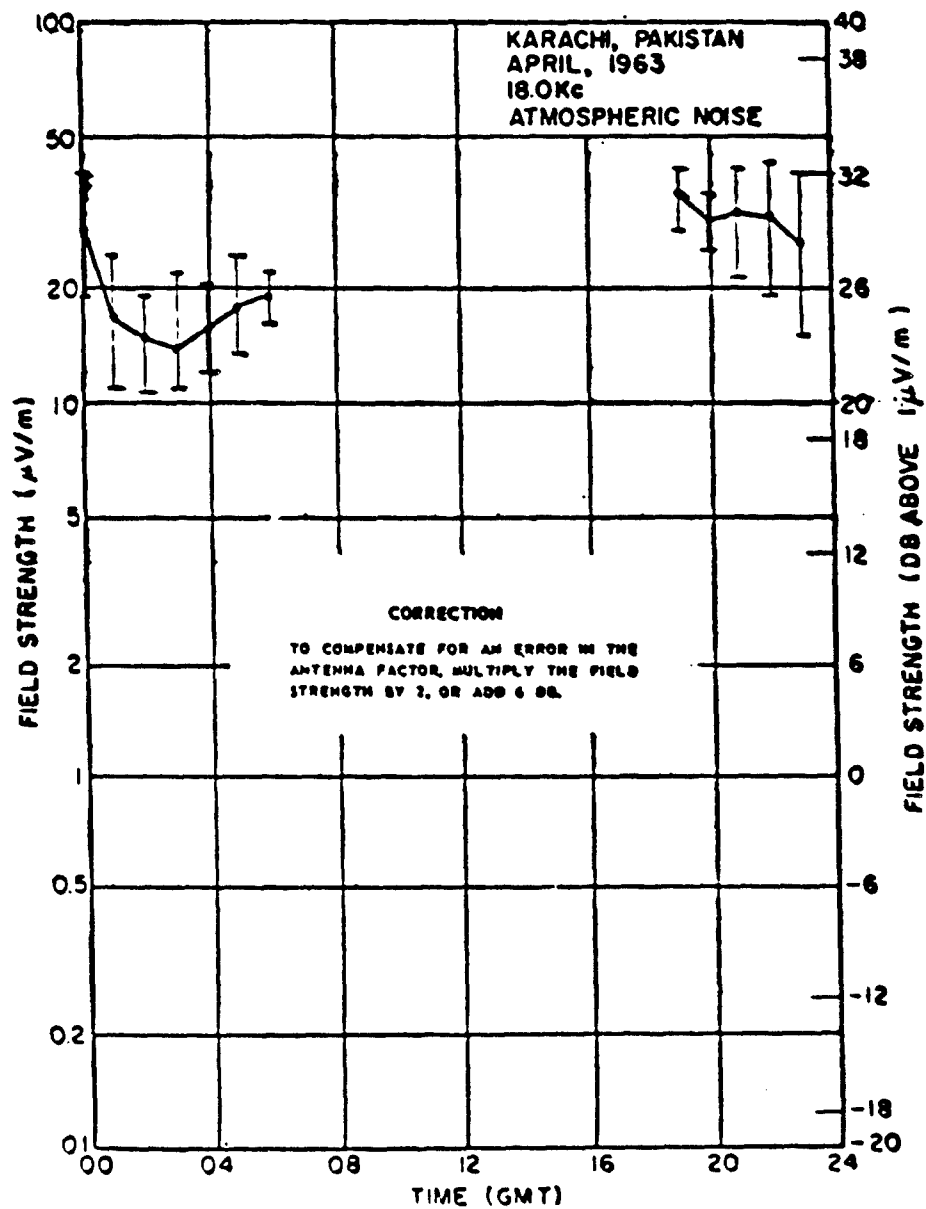


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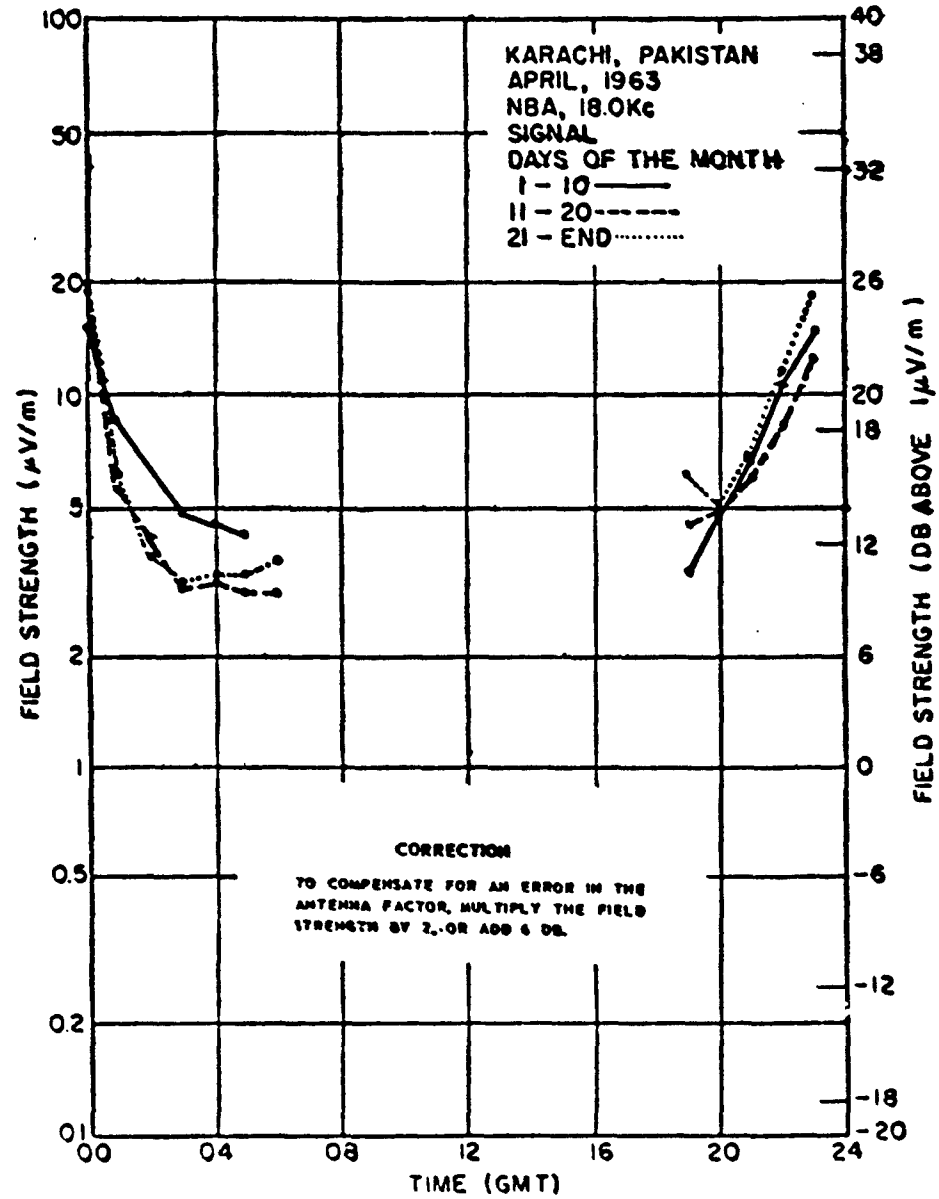


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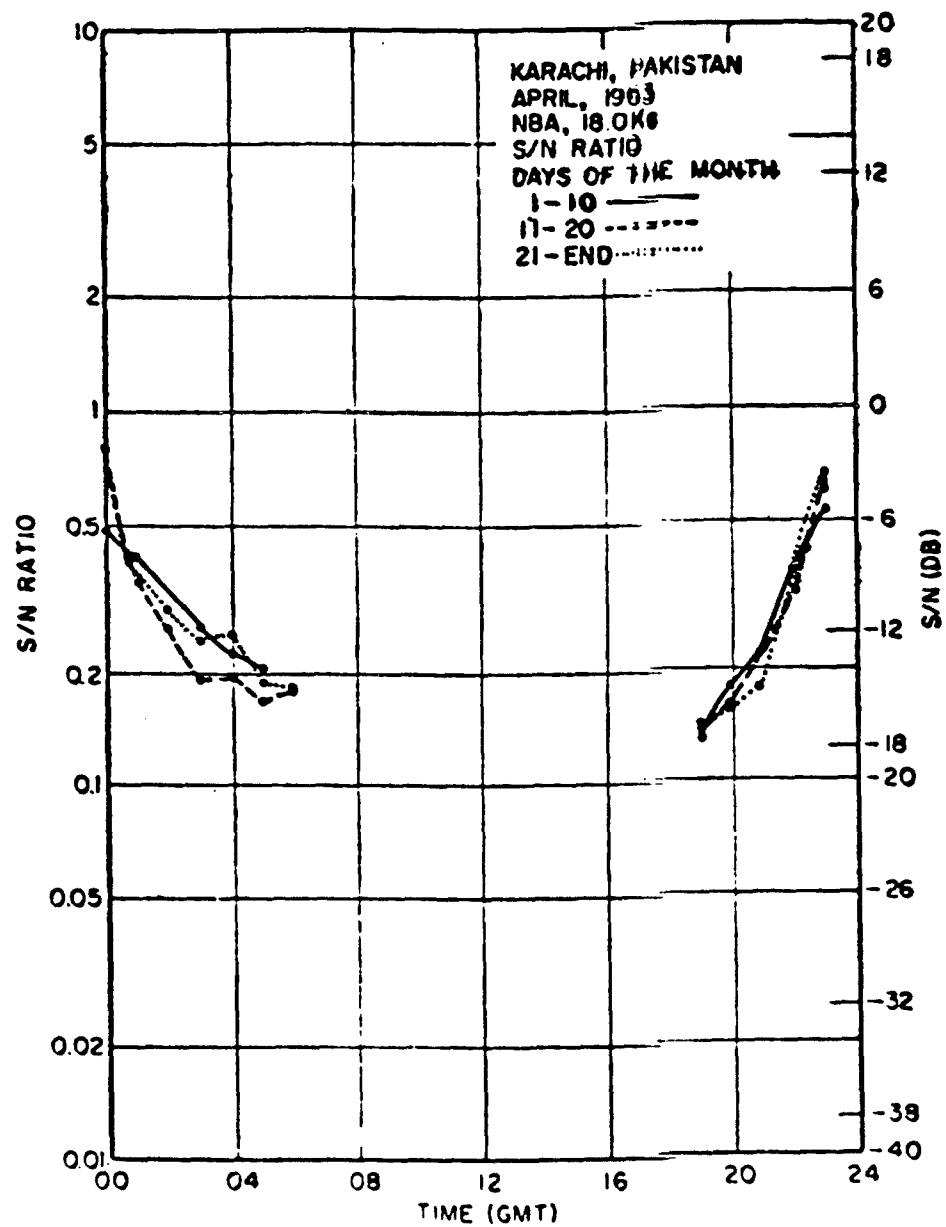


Figure 331

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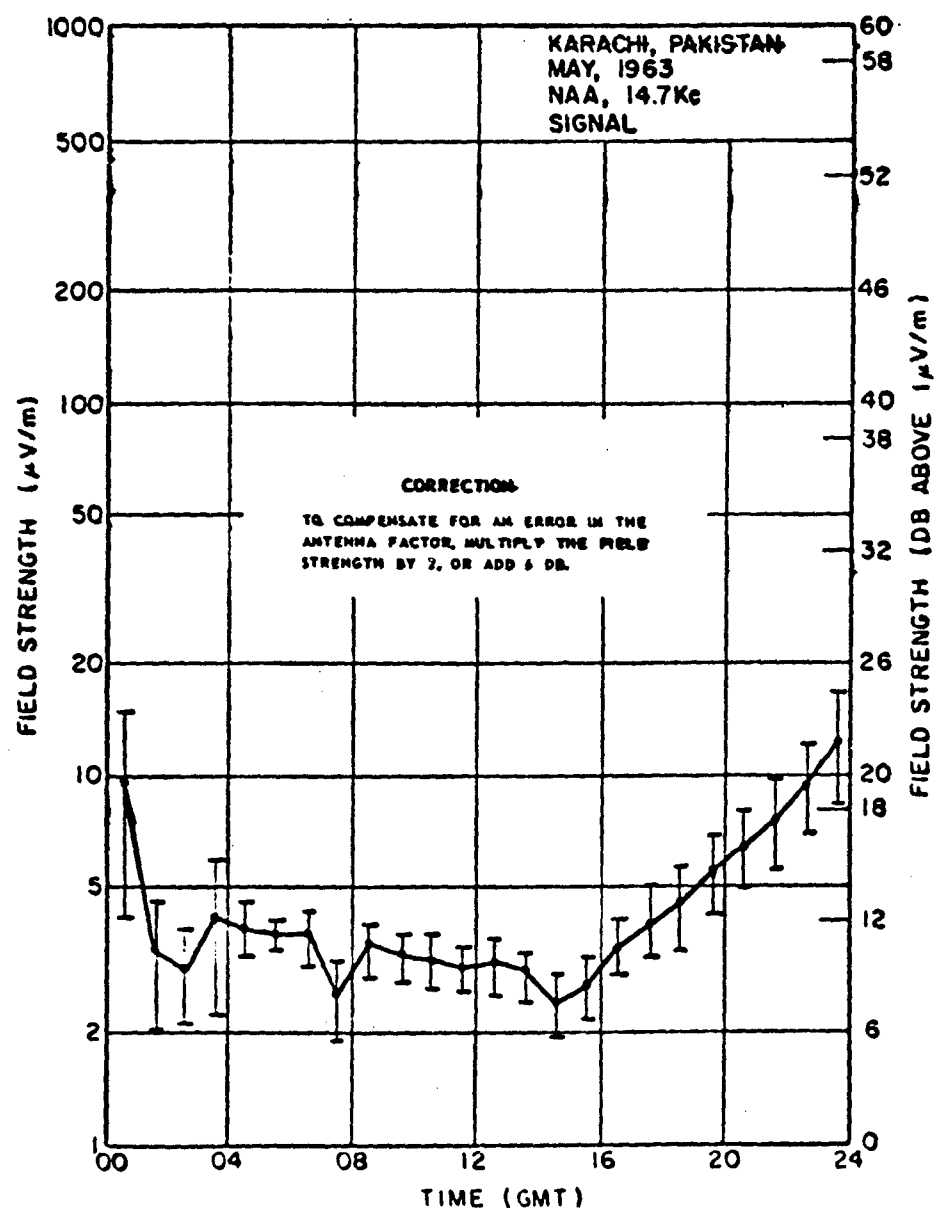


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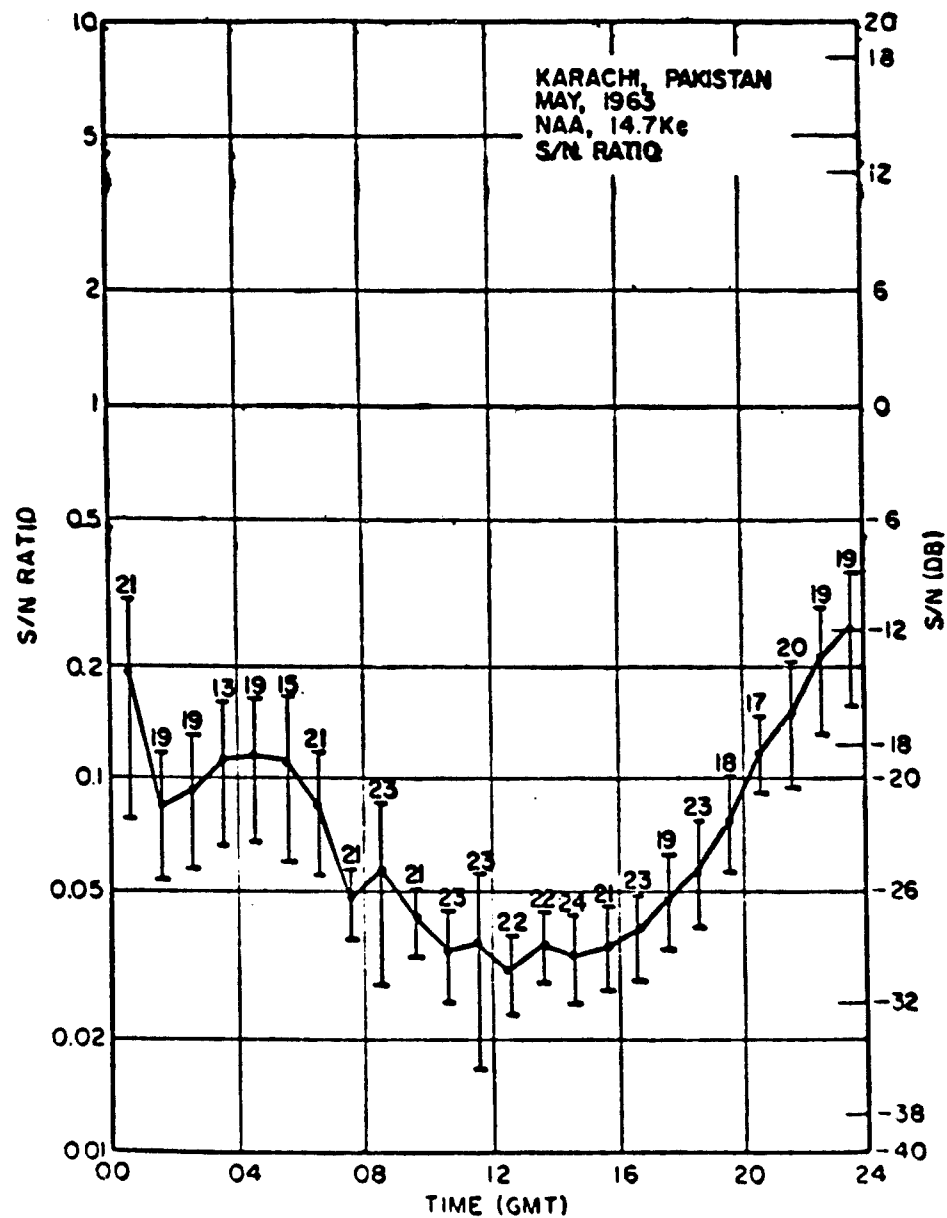


Figure 333

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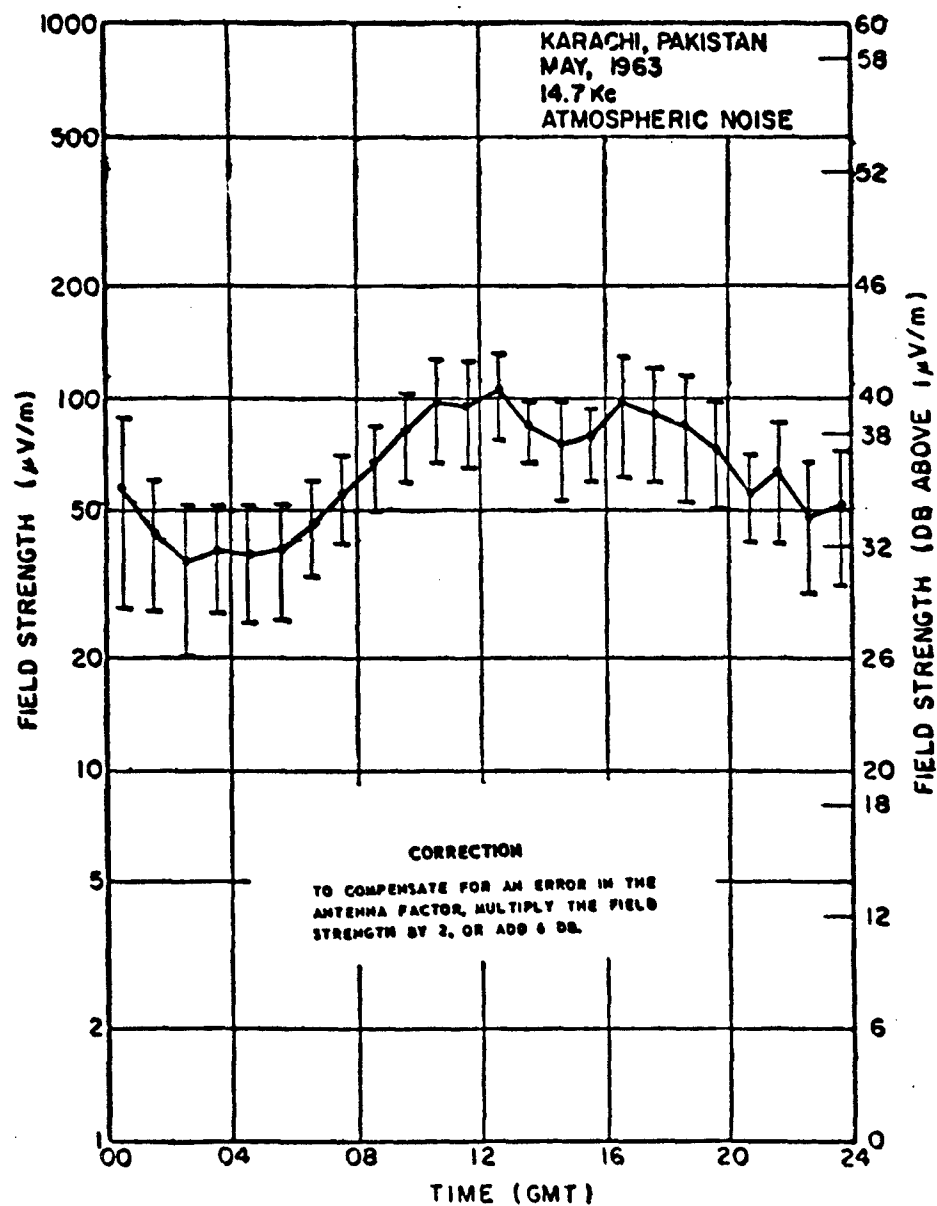


Figure 334

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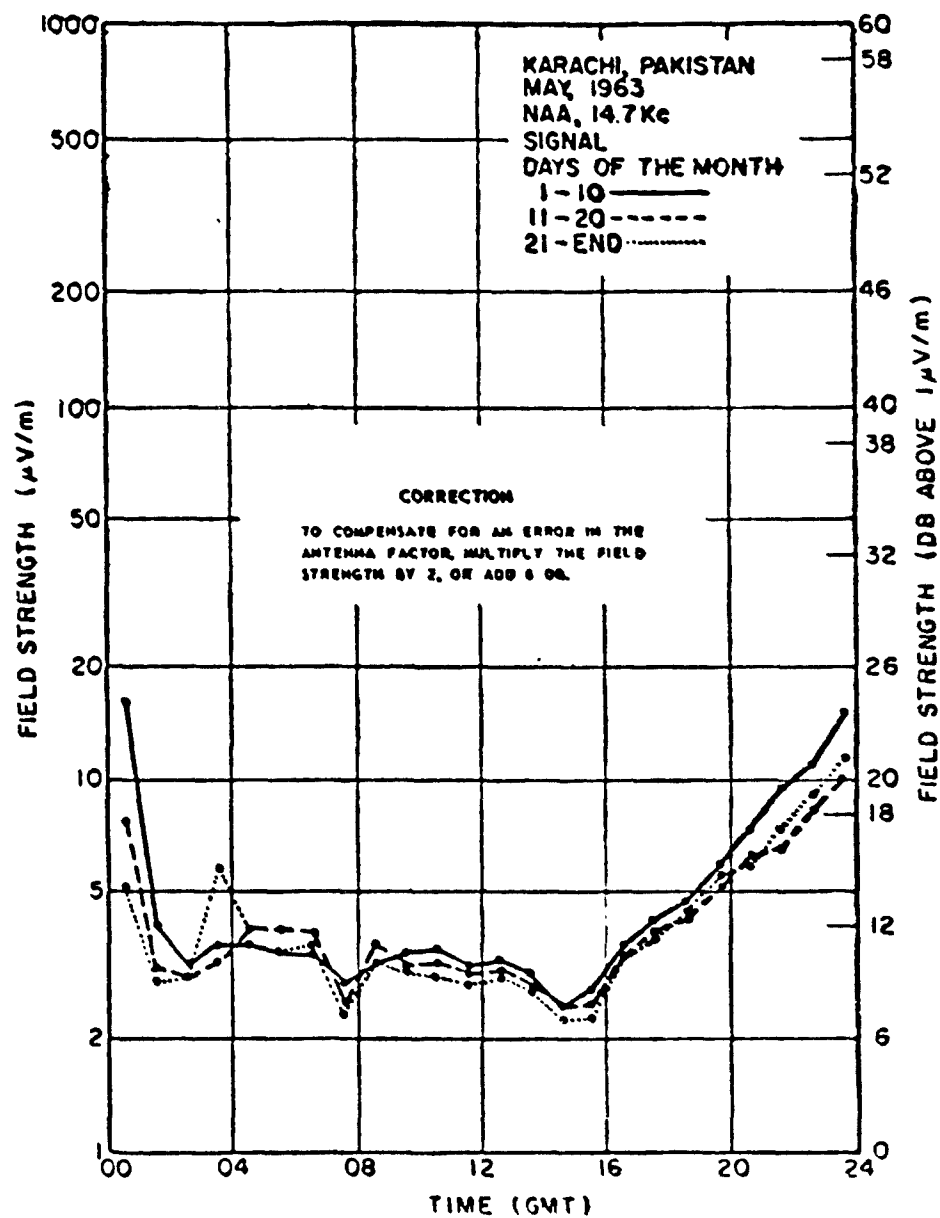


Figure 335

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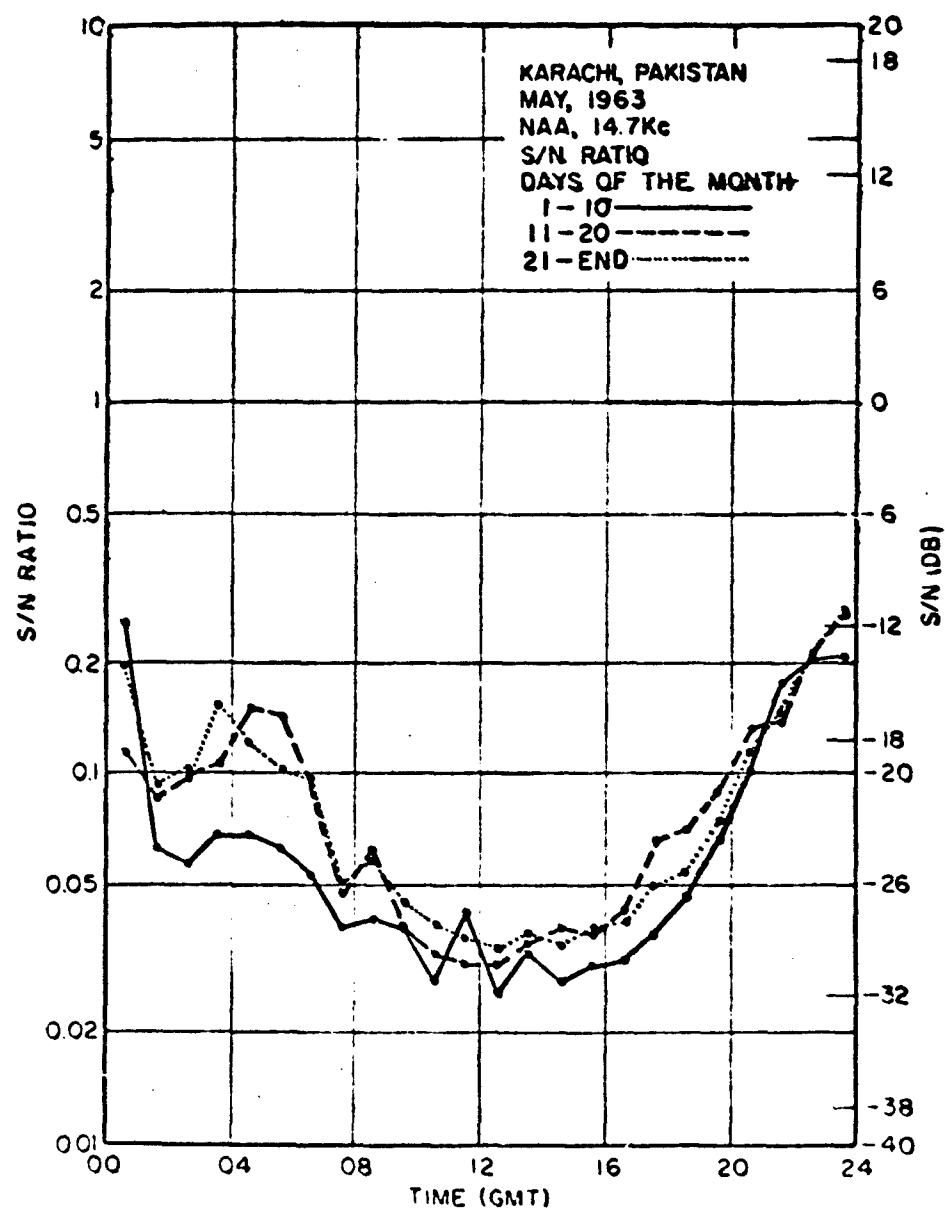


Figure 336

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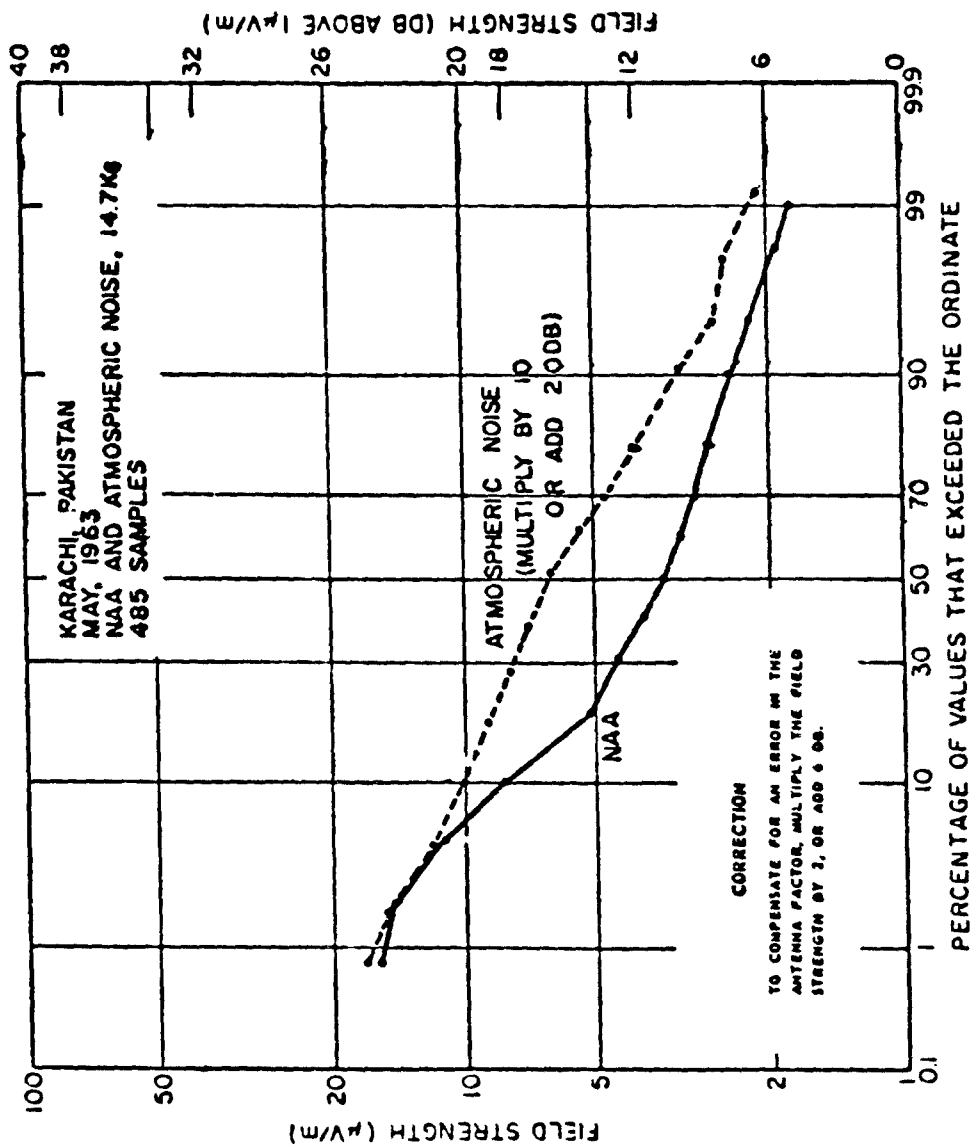


Figure 337

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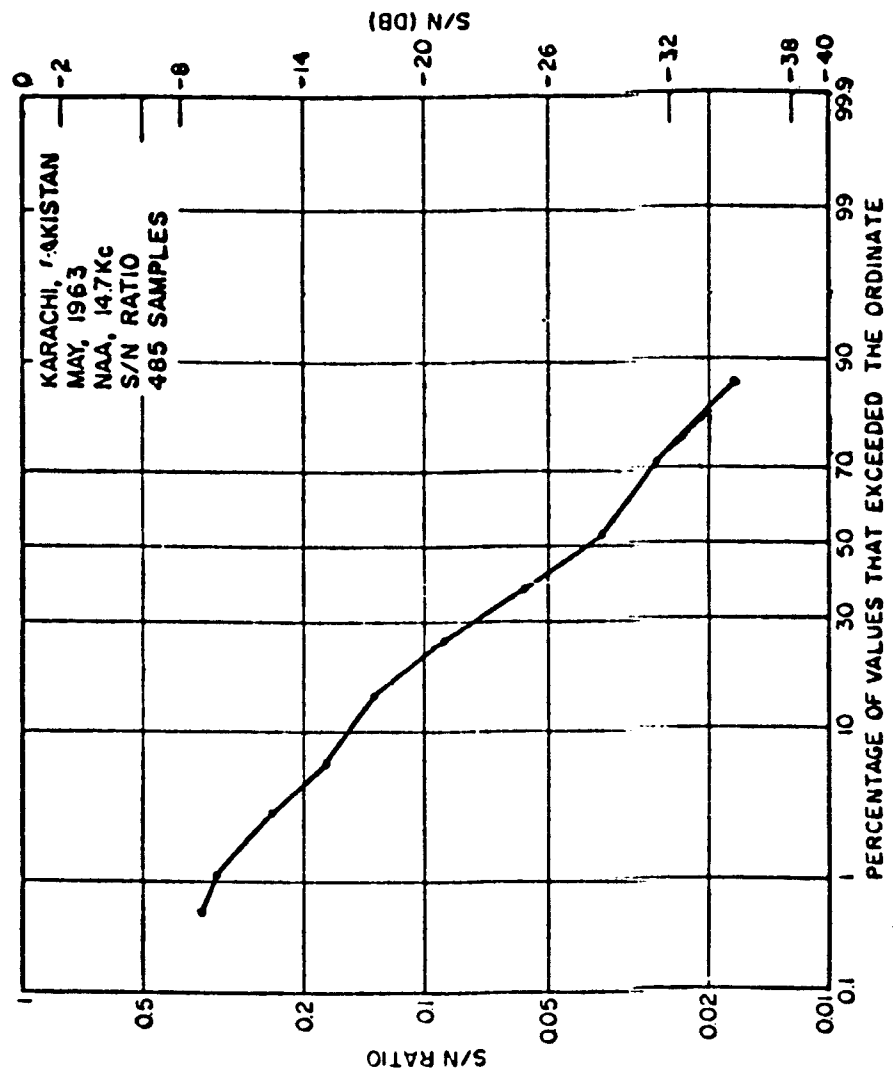


Figure 338

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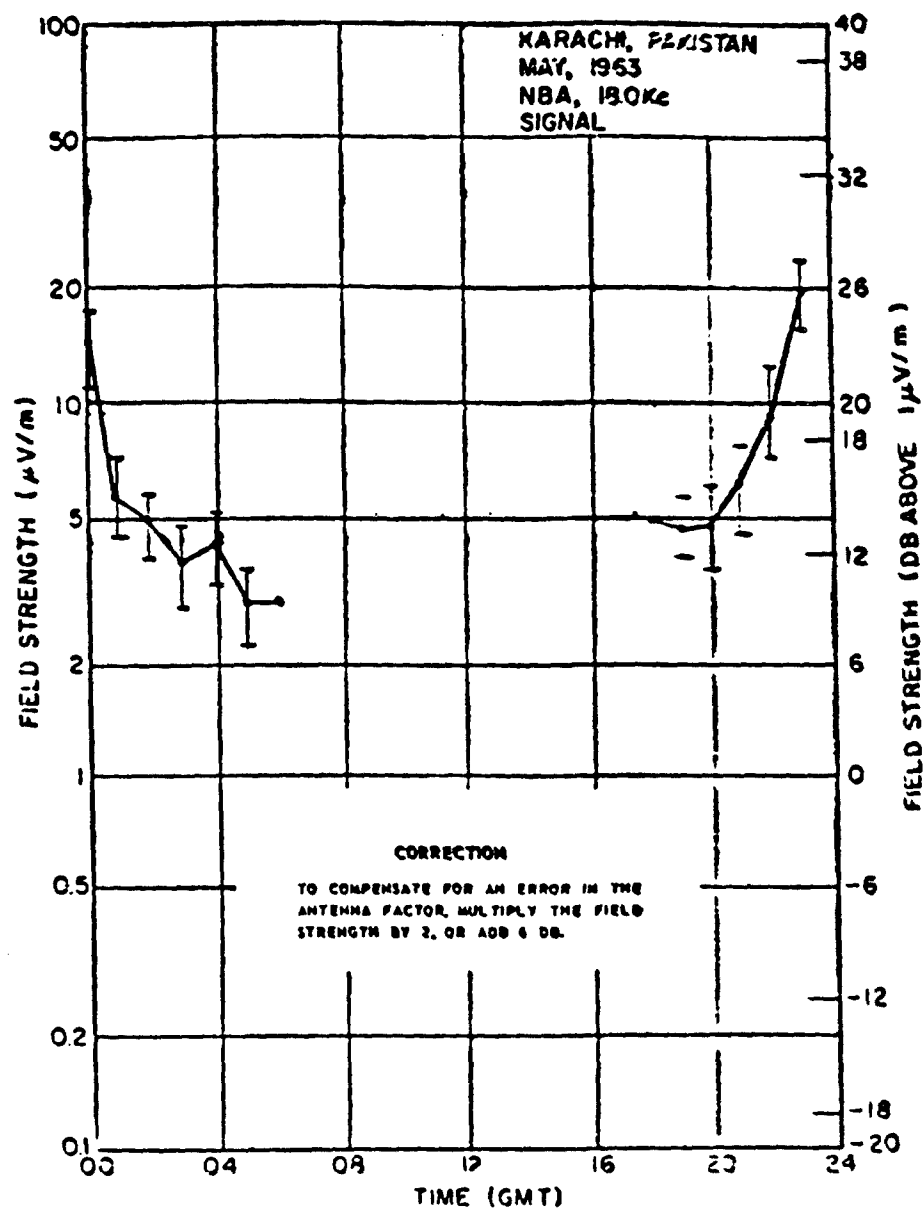


Figure 339

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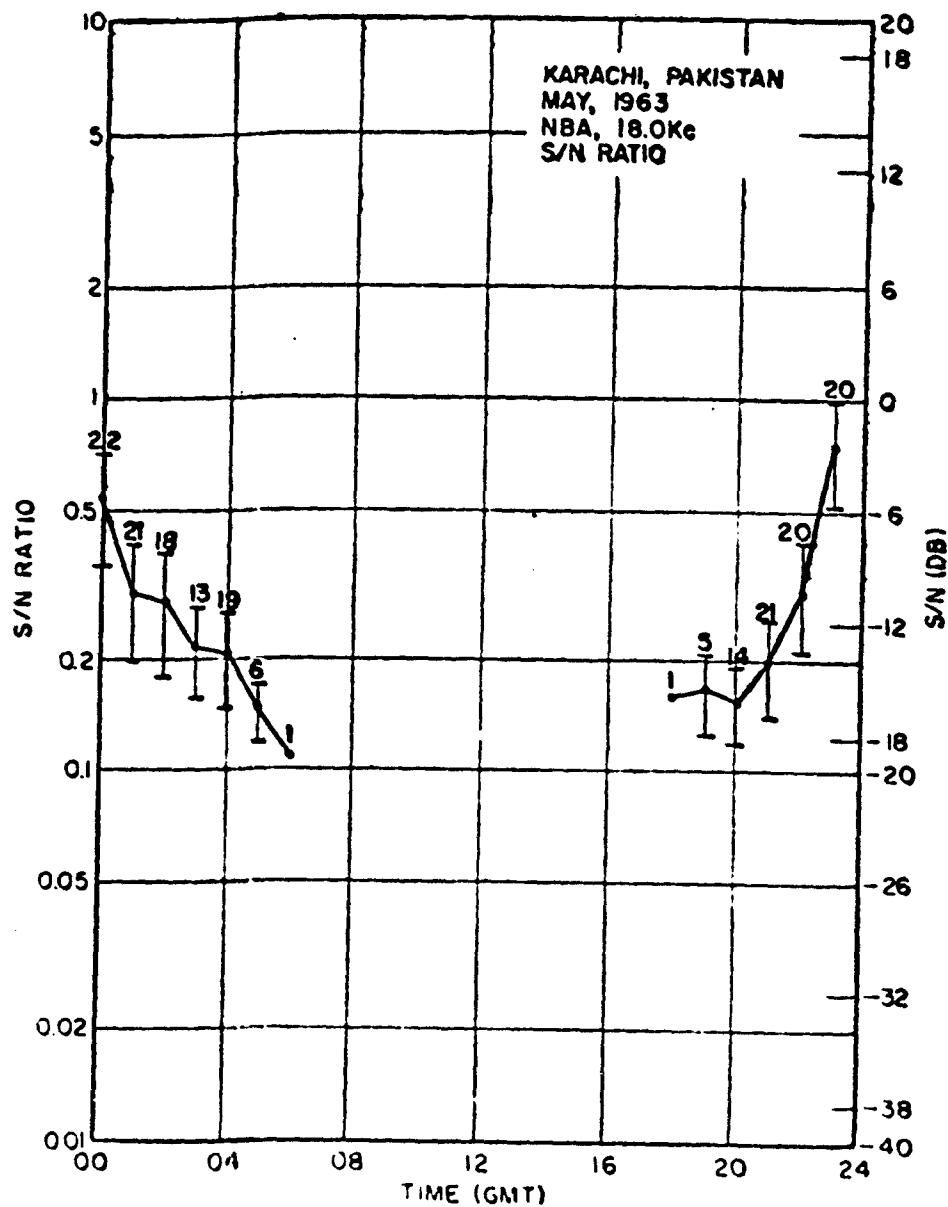


Figure 340

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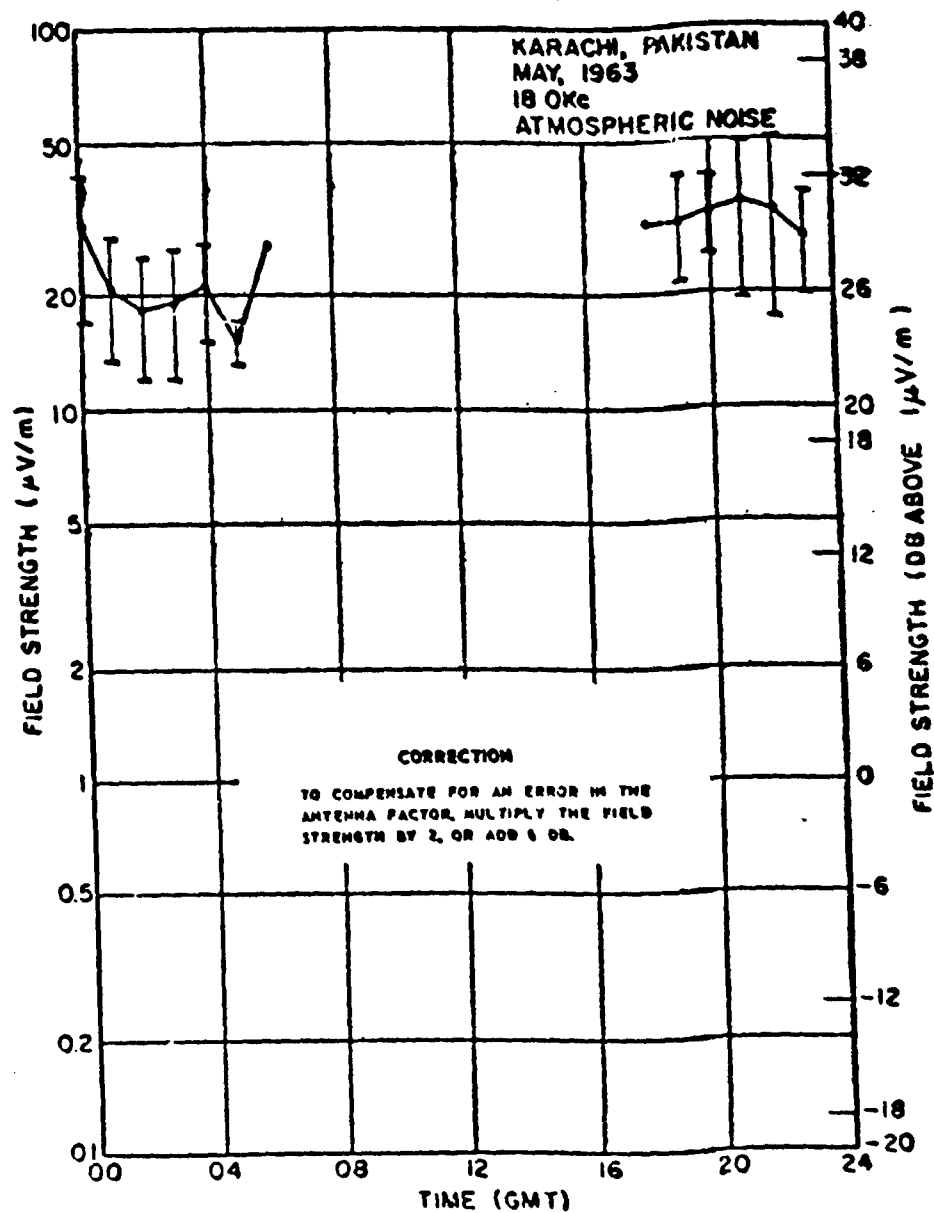


Figure 341

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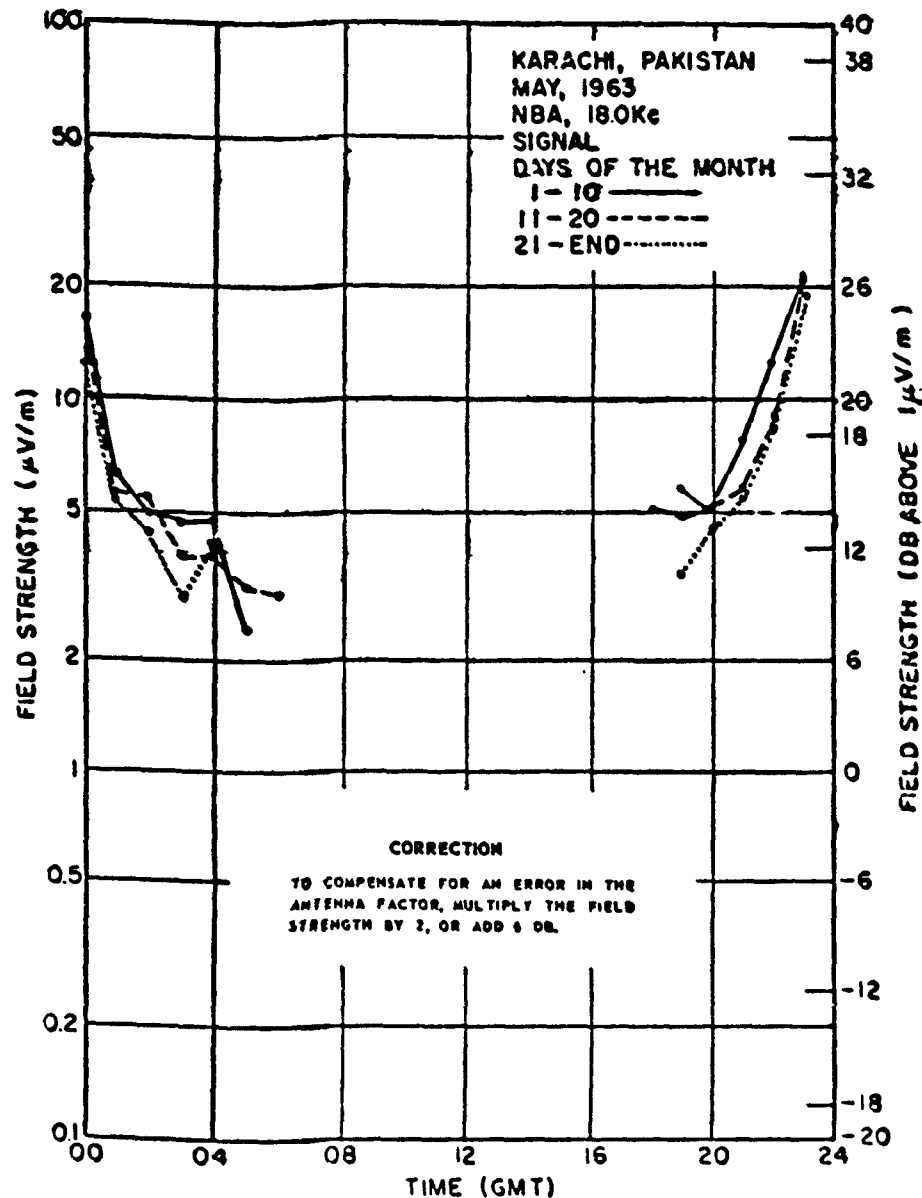


Figure 342

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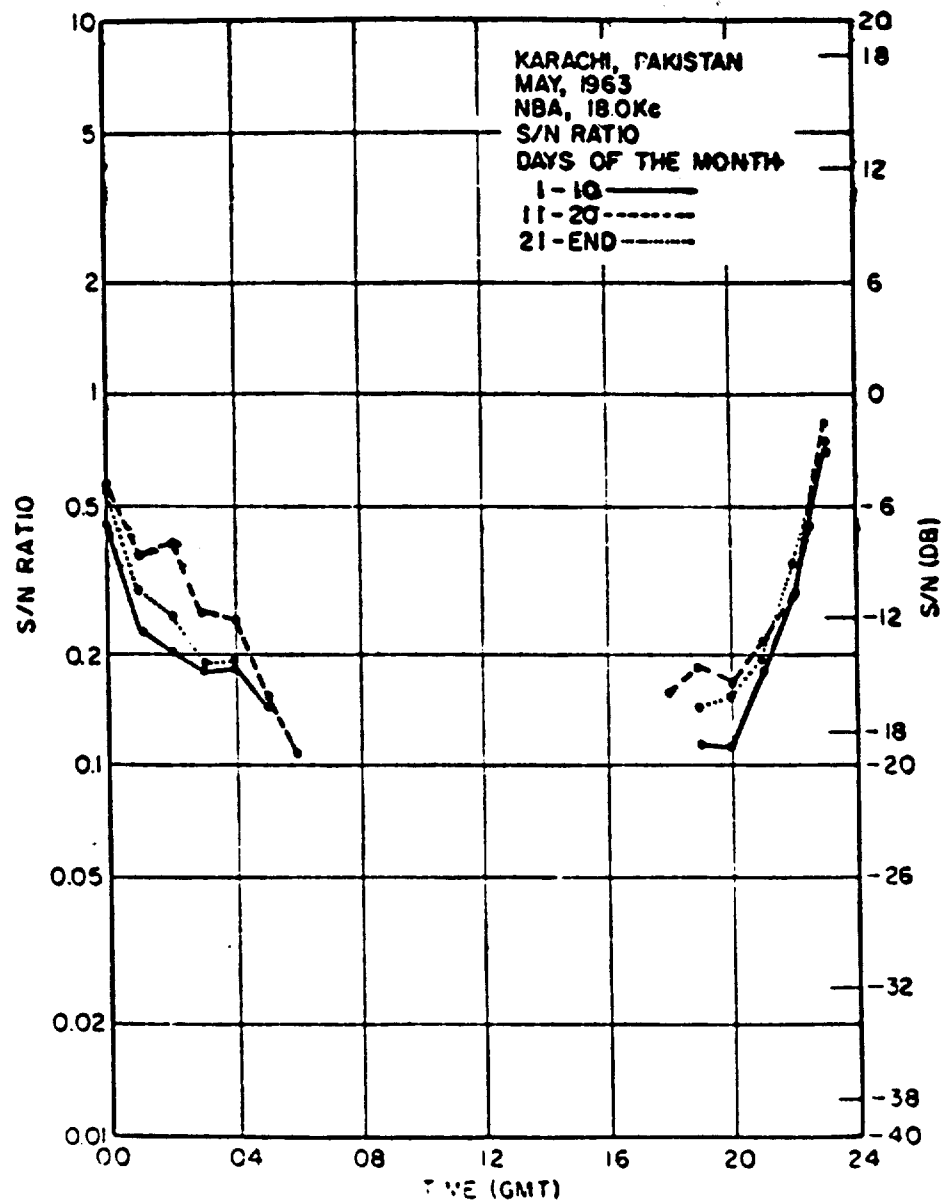


Figure 343

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**Naval Research Laboratory
Technical Library
Research Reports Section**

DATE: June 19, 2002

FROM: Mary Templeman, Code 5227

TO: Code 5300 Paul Hughes

CC: Tina Smailwood, Code 1221.1

f2 6/21/02

SUBJ: Review of NRL Reports

Dear Sir/Madam:

1. Please review NRL MR -1184, MR-1193, MR-1417, MR-1571, MR-1595, MR-1635, and MR-1667 for:

- ☒ Possible Distribution Statement
☒ Possible Change in Classification

Thank you,

Mary Templeman

Mary Templeman

(202)767-3425

maryt@library.nrl.navy.mil

The subject report can be:

- ☒ Changed to Distribution A (Unlimited)
☒ Changed to Classification Unclassified
☐ Other:

Paul K. Hughes II

Signature

6/21/02

Date

-- 1 OF 1
-- 1 - AD NUMBER: 359527
-- 2 - FIELDS AND GROUPS: 20/14, 25/2
-- 3 - ENTRY CLASSIFICATION: UNCLASSIFIED
-- 5 - CORPORATE AUTHOR: NAVAL RESEARCH LAB WASHINGTON D C
-- 6 - UNCLASSIFIED TITLE: FIELD STRENGTHS OF SOME VLF TRANSMISSIONS
-- AND ATMOSPHERIC NOISE MEASURED IN EUROPEAN AND ASIAN AREAS JUNE
-- 1962 THROUGH MAY 1963
-- 8 - TITLE CLASSIFICATION: UNCLASSIFIED
-- 9 - DESCRIPTIVE NOTE: QUARTERLY REPT. NO. 14, JUN 62-MAY 63,
--10 - PERSONAL AUTHORS: GARNER,W. E. ;RHOADS,F. J. ;SCHAUER,R. L. ;
--11 - REPORT DATE: 2 MAR 1965
--12 - PAGINATION: XXXXXX MEDIA COST: \$ 7.00 PRICE CODE: AA
--14 - REPORT NUMBER: NRL-MR-1595
--16 - PROJECT NUMBER: SR008 01 01
--20 - REPORT CLASSIFICATION: ~~CONFIDENTIAL~~
--23 - DESCRIPTORS: (*PROPAGATION, VERY LOW FREQUENCY), (*RADIO WAVES,
-- PROPAGATION), (*RADIO TRANSMISSION, VERY LOW FREQUENCY), TIME,
-- RANGES (DISTANCE), ATMOSPHERIC ELECTRICITY, ELECTROMAGNETIC FIELDS,
-- SIGNAL-TO-NOISE RATIO, EXPERIMENTAL DATA, WESTERN EUROPE, ASIA,
-- NOISE (RADIO)
--24 - DESCRIPTOR CLASSIFICATION: UNCLASSIFIED
--29 - INITIAL INVENTORY: 20

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--30 - ANNOTATION: FIELD STRENGTHS OF SOME VLF TRANSMISSIONS AND
-- ATMOSPHERIC NOISE MEASURED IN EUROPEAN AND ASIAN AREAS JUNE 1962
-- THROUGH MAY 1964.
--32 - REGRADE CATEGORY: C
--33 - LIMITATION CODES: 9
--34 - SOURCE SERIES: 14
--35 - SOURCE CODE: 251950
--36 - ITEM LOCATION: DTIC
--38 - DECLASSIFICATION DATE: OADR
--40 - GEOPOLITICAL CODE: 1100
--41 - TYPE CODE: N
--43 - IAC DOCUMENT TYPE:

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